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Birds in Residential Metropolitan New Orleans Neighborhoods and Their Relationships to the Batture and Yard Vegetation

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Birds in Residential Metropolitan New Orleans Neighborhoods and Their Relationship to the Batture and Yard Vegetation

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ABSTRACT

Neighborhoods near New Orleans were surveyed to gage bird responses to distance from vegetation along the Mississippi (batture), canopy cover, stem counts, and understory vegetation at survey points. Surveys were conducted spring and summer of 2010. One or more tests on species that generally occur in the batture, urban species, and pooled species showed greater spring species richness and abundance in areas with more canopy cover, understory vegetation, higher stem counts, and distances closer to the batture. In one or more summer tests, batture birds had greater richness and abundance in areas with more canopy cover, understory cover, and higher stem counts. Batture birds showed greater richness nearer the batture in summer. Urban birds showed no preferences for vegetation, but showed greater richness further from the batture. Pooled birds didn't significantly respond to variables during the summer. Fifteen species of birds were analyzed, showing some species-specific patterns.

birds, urban, point counts, seasonal, individual species, canopy, understory, stem counts, batture, riparian, New Orleans, residential neighborhoods, yards, Louisiana, vegetation

INTRODUCTION

Urbanization is a global trend that has been occurring with great rapidity. Scientists worldwide have become increasingly concerned with the changes and disruptions that urbanization causes in the environment. Urbanization replaces natural habitat with a new, man-made one, in which a reduced number of species are able to survive. Once an area is urbanized, many of the native bird species are gone. Even if components of the natural habitat are restored, it may not be possible to fully bring back the ecosystem that once was (Bino et al. 2008; Bokony, Kulcsar, and Liker 2010; Chace and Walsh 2006; Rutz 2008).

On a rural to urban gradient, bird populations follow a well documented pattern. Numbers of birds increase with greater urbanization, but species diversity drops. The more rural, natural, vegetated areas surrounding cities have the greater number of species, with the greatest species richness in the edge where residential neighborhoods meet with undeveloped land. There are more varieties of habitats in this convergence zone, thus leading to more species in the area. This phenomenon is well documented, and generally occurs wherever two ecosystems meet. (Blair 1999; Cam et al. 2000; Chace and Walsh 2006; Donnelly and Marzluff 2004; Kark et al. 2007; Liker, Papp, and Lendvai 2008; Moller 2009; Rottenborn 1999). It is interesting to note that butterfly species richness shows the same basic trend as birds in response to urbanization (Blair 1999). In the paper by Young, Daniels, and Johnston, the number of individual birds present in an area was referred to as “abundance” and the number of bird species present in an area was “richness” (Young, Daniels, and Johnston 2007). The same form will be followed in this paper.

Many birds living in highly urbanized areas are not the same species as the native birds in the area. Indeed, the bird populations that inhabit city centers have more in common with bird populations in other distant city centers than they do the bird populations in the natural habitat surrounding the city (Clergeau, Jokimaki, and Savard 2001; Jokimaki and Kaisanlahti-Jokimaki 2003; Chace and Walsh 2006). Cities and urbanization select for certain traits in birds and often select against native species. Birds successful in urban settings are most often generalists (Liker, Papp, and Lendvai 2008; Sanesi et al. 2009). Omnivores, granivores, aerial insectivores, and ground feeders also do well in the more urbanized areas, especially those who can learn to exploit human refuse food sources and bird feeders (Fuller 2008; Kark et al. 2007). Birds that can learn to live in buildings prosper in the cityscape (Kark et al. 2007; Miller et al. 2003). Often these birds are non-natives (also referred to as exotics), and do not stray far from human settlements. They are able to out-compete the native bird populations and take over the new habitat created when people build cities (Cam et al. 2000; Chace and Walsh 2006; Clergeau et al. 1998; Jokimaki and Kaisanlahti-Jokimaki 2003; Kark et al. 2007; Miller et al. 2003).

Birds that have difficulty surviving in urban dominated landscapes include insectivores (excluding aerial and some ground foraging insectivores), birds dependent on native vegetation (especially understory plants), birds dependent on dead trees, and migrants (Clergeau et al. 1998; Kark et al. 2007; Miller et al. 2003). As landscapes become more urban, the plants found within them change. Exotic plants frequently appear in the landscape, which often have fewer insects (or sometimes harbor different types of insects) than the native plants (Young, Daniels and Johnston 2007; Chace and Walsh 2006; Faeth et al. 2005). Dead trees in the city are generally scarce, and some birds lose a source of food when the few remaining dead trees and thus their insect population, are removed from an area. The tree cavities that are available are subject to competition, and often exotic urban birds get the cavities (Chace and Walsh 2006; Kark et al. 2007; Rottenborn 1999). Non-native vegetation is not able to provide for the needs of multiple bird species that originally inhabited an area. It lacks the proper structure, and because it has fewer insects, birds that glean insects from plants often can not find enough food. Many native species of birds, which have evolved to live in the native habitat of the area, die off or leave urban areas as they are unable to survive (Chace and Walsh 2006; Rottenborn 1999; Young, Daniels, and Johnston 2007). Lack of food is especially problematic in the breeding season when parents need to successfully hunt enough to feed themselves and their chicks. Even if birds are able to find non-insect food for their young, the food may not be of as high quality as the insects would have been. This could lead to a decrease in the overall health and fitness of chicks raised on lower proportions of insect food (Chace and Walsh 2006, Shochat 2004). In most landscapes, highly urban areas have less vegetative cover than other areas in the city. Very little vegetation is a condition with which most species can not deal. Nonetheless, it should be noted that areas with a very high density of trees, to the point where the canopy is complete, may have very few birds because the understory plants can not live in such low light conditions (Donnelly and Marzluff 2005, Miller et al. 2003) . Migratory birds are faced with the challenge of ousting the non-migratory, city dwelling exotics from potential nesting territories. Often, the migrants are not able to succeed at this challenge and do not live within urban areas as a result (Kark et al. 2007). (Chace and Walsh 2006; Faeth et al. 2005; Kark et al. 2007; Liker, Papp, and Lendvai 2008; Rottenborn 1999; Sanesi et al. 2009; Young, Daniels, and Johnston 2007).

Urban birds may have behavioral traits that allow them to thrive in cities. Species that fare well in cities tend to have lower levels of fear, and do not fly as far away when startled or scared by something (Tsurim, Abramsky and Kotler 2008). They are also able to disperse and colonize new areas when the opportunity arises. Feeding methods are adaptable, and urban birds are able to learn how to exploit human sources of food (Moller, 2009). House Sparrows (*Passer domesticus*), a well known urban species, will stay at forage sites with lower densities of food than the closely related and more rural Spanish Sparrow (*Passer hispaniolensis*). Also, these House Sparrows did not seem to be averse to foraging in places further away from the protective cover of vegetation (Tsurim, Abramsky and Kotler 2008). It is possible to inhabit cities all year round so birds that do not migrate have the advantage in cities. Bird feeders, other anthropogenic sources of food, and urban heat island effects all allow for city-dwelling birds to stay put during the cold months, and thus avoid the perils of migration and in addition, keep their territory over winter (Chace and Walsh 2006; Faeth et al. 2005; Moller 2009).

As previously noted, cities have higher numbers of birds than natural habitats. One of the first to note this phenomenon was Pitelka in 1942 who wrote about the abnormally high numbers of birds he saw in a Southern California town (Pitelka 1942). Though at the time Pitelka spoke of the shortcoming of the scientists of his day in declining to study urban areas, this error has been remedied in recent times. Multiple studies have been done as to why there is such an abundance of birds in cities. One theory, entitled the “credit card” theory, states birds can count on resources being present in cities in the future. Because of this, they are able to reproduce at higher rates today (even if the food supplies are a little low) because they know that tomorrow there will be the needed food items available to rear their young (Shochat 2004). Most urban birds are social, which allows them to forage in groups. Group foraging allows all members of the flock to find food with greater efficiency. Also, because social birds in a flock have more eyes looking for predators, they are better able to avoid predation. Flocks of birds of the same species also have an advantage in defending their resources against other birds that might wish to use the same resources (Kark et al. 2007). Those birds that can exploit anthropogenic sources of food have an abundant and continuous food source (Moller 2009; Tsurim, Abramshy and Kotler 2008).

It is interesting to note that birds of prey do well in cities. They may have individual ranges that include parts of the city, but ranges can also include areas outside of the city. Cities have advantages for birds of prey. While they are in the city they are protected from harassment, especially shooting. Such harassment may push these birds into urban areas. Other things may pull these birds into cities. There are ample food resources in the form of small birds and mammals. Buildings make acceptable nesting sites for some species. Hawks that hunt larger prey (as hawk prey goes) are not as drawn to the city as the birds that hunt smaller prey. (Chace and Walsh 2006; Rutz 2008).

Cities are full of many hazards for birds. Colliding with buildings is one of the better known phenomena, and birds have the same difficulty with windows. Power lines can be dangerous for larger avian species should they fly into them. Birds are frequently hit by cars, and this problem is at its highest levels during mating season, when parent birds are foraging for themselves and chicks, and may be more territorial (Chace and Walsh 2006; Guymon, per. obs.; Rutz 2008). Northern Mockingbirds (*Mimus polyglottos*) may be so occupied with chasing one another that they fly directly in front of vehicles (Guymon, per. obs). On a different note, cities very likely have higher levels of pollutants which would have a negative impact on city-dwelling birds since birds are sensitive to contaminants (Liker, Papp, and Lendvai 2008; Yaukey 2008). Rates of illness in adults and nestlings have been found to be higher in some studies of urban birds (Chace and Walsh 2006; Rutz 2008).

The predatory effect of cats is an item of debate amongst ornithologists. Cats are not dependent on natural sources of food including many strays that are fed by humans. Thus, cities can have abnormally high cat densities when compared to natural systems. In the United Kingdom as of 2007, the density of cats was three times higher than similar predators in wild ecosystems. It is possible that cats have a negative impact on bird populations. Aside from directly killing birds, it may be that some birds are wary of nesting in areas with so many predators around (Beckerman, Boots, and Gaston 2007). Birds may modify their behaviors and habitat use in response to the presence of cats. However, some believe that cats do not have a very large impact on urban bird populations, and that there are other things that have more dramatic negative influences on their populations, though cat predation surely does not benefit bird population numbers (Beckerman, Boots, and Gaton 2007; Burhans and Thompson 2006; Faeth et al. 2005; Shochat 2004)

If the impact of cats on birds is disputed, the effect of nest parasitism by cowbirds is not. Many of the native birds that are found within cities have higher rates of nest parasitism than their rural counterparts. Cowbirds parasitize open cup nesters, and since many exotic urban birds are cavity nesters, they are not as impacted by cowbirds. Many native birds are open cup nesters, and thus will be targeted by cowbirds (Melles, Glen & Martin 2003). Parasitized Acadian Flycatchers fledged no young in one urban study (Rodewald and Shustack 2008). Many species of native birds living in cities have lower nest success than birds living outside of the city (Burhans and Thompson 2006; Chace and Walsh 2006; Rodewald and Shustack 2008).

Vegetation in cities, even vegetation that is not entirely natural, may be attractive to native birds, though the best habitat for native birds is likely to be natural vegetation (Chace and Walsh 2006). Many cities have remnants of natural vegetation, or at least areas with mostly native vegetation. These areas are often found in parks, preserves, greenways, and riparian corridors. The value of these areas is great, but there are things that can degrade them. Migratory birds often use forests, but the use of forest patches inside of the cities is disputed. Some claim migrants will not use the patches inside cities (Rottenborn 1999, Miller et al. 2003), but others feel that short distance migrants show no hindrance in using urban patches (Burhans and Thompson 2006). A third possibility is that though urban surroundings, especially buildings, will degrade a patch of forest, it will still be used by migrants and that larger patches will serve greater abundances and species richness of migratory birds (Chace and Walsh 2006). Dogs and cats can prove disruptive to birds, and cause birds to avoid areas that the human pets frequent (thought some remnant vegetation still has natural predators, which deter cats) (Faeth et al. 2005).

Frequently, natural areas have trails and sometimes roads within their boundaries. Birds often avoid trails, and roads can serve to fragment habitat. Roads and trails also allow access to humans, cats, dogs, and vehicles which disturb birds and create unnatural noise in the area. Danger of collision increases for birds living near roads and trails (Chace and Walsh 2006, Miller et al. 2003, Wood and Yezerinac 2006). There is evidence that buildings that are not inside the vegetated area can still influence the bird populations (Rottenborn 1999). Some birds will avoid vegetation that has houses nearby, especially species that forage low to the ground, most likely because of the disturbances of humans and their pets (Miller et al. 2003). Also, species richness near buildings drops. Bridges were strongly avoided by birds in one study concerning riparian corridors by Rottenborn, possibly due to the increased traffic, or because they fragmented the habitat (Burhans and Thompson 2006; Rodewald and Shustack 2008; Rottenborn 1999).

Cities are noisy places, and noise can have an adverse effect on birds. Birds could have their ability to detect predators impaired in noisy areas. This can be done by the birds simply failing to hear the predator, or being unable to hear the warning calls put out by their neighbors. Songbirds, though, are presented with a special problem when it comes to noise. Often times, the noise occurs at the same frequencies as parts of their songs. This makes it more difficult to attract a mate and defend a territory. Birds can respond to this problem in several ways. Some move out. Some sing louder. Others modify their song to exclude the parts of their songs that area masked by noise (Wood and Yezerinac 2006; Yong 2008). This may be done by adult birds learning which songs are the least masked and thus the most effective, or simply by young birds never hearing, and thus never learning, the masked parts of the songs. One other method of combating urban noise is to change the time at which birds sing. Some birds sing earlier in the morning and later in the evening when traffic sounds die down. Nonetheless, these phenomena can not have a good impact on bird populations. It should also be noted that while some urban birds do sing (for example, Northern Mockingbird [*Mimus polyglottos*], American Robin [*Turdus migratorius*], Barn Swallow [*Hirundo rustica*]), many do not. (Chace and Walsh 2006; Rottenborn 1999; Wood and Yezerinac 2006; Yong 2008).

Riparian corridors are the homes of many species of creature and plant. They are far more important than their area would imply. People prefer to live near bodies of water for the many necessities and conveniences that water provides. Because of this, many riparian corridors are degraded, disturbed or destroyed by people (Miller et al. 2003). There are many ways to degrade a riparian corridor. Some ways include bisecting it with roads, trails or bridges. Placing roads or buildings in or near corridors also negatively impacts the riparian area. However, the worst thing that can be done as far as birds are concerned is to destroy the native vegetation (Rottenborn 1999).

Metropolitan New Orleans has a few riparian corridor remnants (locally known as the "batture") along the Mississippi River. The Batture is an area of mostly natural vegetation, and is likely to be as undisturbed as is possible in a city. It is seasonally flooded (some areas are permanently flooded), always muddy, and located on the river side of the man made river levees. Trees, brambles, grasses, aquatic plants, and herbaceous vegetation grow there, and it is thought to be a harbor of wildlife in the city. The purpose of this study is to see how these batture remnants affect urban bird populations living in residential neighborhoods in metropolitan New Orleans. Variation in bird abundance and species richness with increasing distance from the batture will be examined. Vegetation within residential neighborhoods themselves also may play a role in bird populations. Thus, the impact of vegetation within residential properties will be evaluated as well.

METHODS

Survey Area Selection

Areas had to meet certain criteria to qualify as survey areas. They had to be within or on the outskirts of Greater New Orleans. Survey areas were in residential areas dominated by single family dwellings. These areas had to share a border with the batture, and extend continuously for more than 1 km on a line perpendicular to the batture. Areas that flooded during Hurricane Katrina were not included because of possible bird population disturbances caused by the storm (Yaukey 2008). The batture that bordered study areas was required to be at least 50 m wide. The batture was to be free of paved roads, parking lots, or buildings. The presence of walking trails or abandoned/seldom used gravel or dirt roads within the batture did not eliminate areas from the study. Indeed, these trails and roads were used whenever possible for survey points due to the inaccessibility of many parts of the batture. Google Earth was used to find potential suitable study areas, which I visited to ensure that they met the qualifications. Four locations were selected in Old Jefferson, River Ridge, St. Rose and Harahan. The boundaries of the study areas were located 125 meters from the border of any industrial area or large area of native vegetation (minus the batture). The batture has variable widths, and study area borders were to end >125 meters from any areas of batture that were < 50 m wide.

Survey Point Selection

A set of survey points consisted of 21 individual points, one taken inside the batture, and then at every 50 meters from the edge of the batture up to one kilometer away. Old Jefferson only had one set of points due to its small area, but all the other survey areas had two sets of survey points. Thus, seven sets of points were created in total.

Sets of points were picked using the following method. First, using Google Earth and MapQuest, a list of all roads in each study area was compiled. Roads for each study area were kept separated from roads in other study areas. Each road was put into a spreadsheet and assigned a random number. Distances were determined using the measuring tool available on Google Earth. To pick a point 100 meters from the batture, the first road on the list was selected by its random number. If it had a point that was 100 meters distant from the batture border as measured with the Google earth measuring tool, that point became the 100 meter survey point for the set of points. If there was no point 100 meters distant, the next road on the road list was used, and the process was repeated until a point 100 meters distant was obtained. This same routine was followed to select all points from 100 meters to 1000 meters distant from the batture border. When the list of roads was exhausted, each road was assigned a new random number and sorted anew, according to the new random number.

Points within the batture and points 50 meters distant from the batture were found with a slightly different methodology. Because of the swampy terrain of the batture, roads and trails were located and used for the batture survey points whenever they were present. This ensured accessibility to the same point during normal high batture water levels. The next road on the random list was located on Google Earth. Then, whatever elevated path in the batture was closest to the road was selected for the batture point. In instances where elevated paths were not available, the point in the batture closest to the road was selected as the batture point. Due to a lack of elevated paths/roads at both River Ridge batture survey points, I was unable to go to the exact location of the survey point in the summer because of higher than normal levels of water. In this case, I got as close to it as possible and conducted the survey there. It should be noted that batture point surveys were always done within the batture, not on the edge of the batture. The points 50 meters distant from the batture border used the same basic methodology as the batture points, except the 50 meter survey point was not selected because it was on a road or trail. It was simply the place that was 50 meters distant from the batture that was closest to the next road on the roads list

Survey points were to be at least 100 meters apart from any other point included in either set of points in a study area. Additionally, all points had to be at least 50 meters away from the Jefferson Highway. Preliminary surveys determined that areas near the Jefferson Highway were unsuitable because of a lack of bird habitat. The road is approximately 23 meters wide and the heavy traffic patterns may keep birds away from the area. Additionally, the noise from the cars made it difficult to hear any birds in the vicinity. It should also be noted that many places along the Jefferson Highway are commercial, not single family residential. To avoid bias, points were physically located without scouting of bird population distributions.

Bird Surveys

Surveys were performed for two seasons in 2010. Spring surveys were from March 14, 2010 to April 1, 2010. Summer surveys were from June 10, 2010 to June 28, 2011. Different groups of birds were expected to be present during the different survey periods. During the spring surveys, many wintering species would still be in the area, and resident birds (non-migratory) were expected to be prominent on the landscape as well as they would be starting singing and other preparations for nesting. For the summer, it was expected that summer migrants would be in the area and nesting, and residential birds would be in the ending part of their nesting season. Residential birds were expected to be present for both seasons, but they may have been using the area differently because of their different tasks in the different seasons. (Lowrey 1974)

I conducted all bird surveys. Surveys were performed via point counts at the selected survey points. Each point count lasted five minutes, and had a radius of 25 meters, measuring from the middle of the road. Distances were assessed visually. Birds that simply flew over a survey point without landing within the 25 meter radius were not counted, save for falconiformes, vultures, anhinga (*Anhinga anhinga*), hummingbirds, swifts and hirundids. It was assumed that if birds in these groups were circling the survey point, they were using the point. Hummingbirds hovering about in the point, especially if they were feeding, were counted as using the point. Unidentified birds were included in evaluations of abundance, but not species richness. There were occasions when I was unable to tell if a crow was a Fish Crow (*Corvus ossifragus*) or an American Crow (*Corvus brachyrhynchos*). In such cases, I tallied them as unidentified crows. They were included in abundance evaluations in all cases, but were only included in richness evaluations if no identifiable crow was present at that survey point. Two types of grackles were present in the survey, Common Grackles (Quiscalus quiscula) and Boat-tailed Grackles (*Quiscalus major*). Due to my oversight, they were not tallied separately and are counted as unidentified grackles. Unidentified grackles were used in richness and species counts. In the spring, all hummingbirds were unidentified to species. These were included in abundance and richness tests. During the summer, the only type of hummingbird in New Orleans is the Ruby-throated Hummingbird

(*Archilochus colubris)* so there were no issues with unidentified hummingbirds. In the case that a bird flew from one survey point to another survey point, only the first encounter of the bird was recorded. Occasionally, birds occurred in large flocks. This happened frequently with Cedar Waxwings (*Bombycilla cedrorum*) and grackles. In order to prevent skew from large flocks of birds, a flock size limit of more than 30 birds was set. If a flock exceeded 30 members, it was excluded. Flocks of birds were not excluded from richness evaluations, only abundance evaluations.

One set of points was surveyed every consecutive morning possible until all surveys were performed. Surveys were not performed on mornings that had constant rainfall. Sets were covered in the following order; Old Jefferson, River Ridge A, St. Rose A, Harahan A, River Ridge B, St. Rose B, and Harahan B. Each set of points was visited twice. The second time a set of points was frequented, they survey points were visited in reverse order from when they were visited the first time. Surveys began no more than a half hour after sunrise, and continued until all survey points were completed. If a survey was interrupted by rain, I waited for the rain to pass and continued the survey. If the rain did not pass in time for me to complete the survey within six hours from sunrise, the survey was postponed until the next day, at which point surveying resumed at the same time it was discontinued. If winds exceeded 12 mph, surveys were not done that day. In the case that a survey was interrupted for less than a minute due to a curious onlooker or property owner, I paused my stopwatch, and then resumed the survey. For such interruptions lasting more than a minute, I repeated the five minutes.

Although all points were located in the middle of the road (except for some batture points and 50 meter points) surveys were performed on the sidewalks to either side. Each set of points was surveyed twice in spring and twice in summer. On almost all second surveys, I stood on the opposite side of the road. In the few instances where a thin median was available in the middle of the road, the surveys were done from the median. Movement in the survey point was allowed to assist in identification. All surveying was to be completed within six hours from sunrise. Protocol for surveys was created from a mix of the Institute of Bird Populations protocol for their Monitoring Avian Productivity Survey and the United States Forest Service protocol for the Northwest, with adaptations for urban settings (Desante 2007; Huff et al. 2000).

Vegetation surveys for canopy and under story vegetation were performed in October 2010 by visual assessment. Understory cover was defined to be 0.5 meter to 4 meters tall (Little, 1980). The percentage of area within a 25 meter radius that was covered by understory from a bird's eye view was recorded. This included tall grasses and other herbaceous plants, shrubs, and lower limbs of trees. Tree trunks were not included. Canopy was considered to be any vegetation that was over 4 meters tall (Little, 1980). At two survey points, there were known occurrences of trees having been trimmed between the time of the beginning of the first bird survey and the vegetation survey. Since I had not decided to account for vegetation until after the bird surveys were over, I used the vegetation present in October for the vegetation evaluations since it was questionable that I would remember exactly the percentages of plants that were present several months in the past. Though it would have been better to have done the vegetation surveys at the time of the bird surveys, the October vegetation had not suffered losses due to the onset of fall (it was a warm year), and were the best data obtainable. Tree counts were performed in May 2011 but due to the high level of the Mississippi River, batture points were inaccessible and therefore not counted. If I noted a tree had been cut in the point count site that was standing during the bird surveys, I counted it in my tree survey. Trees were defined as being plants that were erect, woody, perennial, with a trunk at least 7.5 centimeters wide at a height of 1.3 meters, a definite crown, and reaching at least a height of 4 meters (Little 1980). Bird species richness and bird abundance were examined in conjunction with increasing distance from the batture, and the percentage of cover of canopy and understory vegetation and stem counts at a survey point.

Analysis

Data were entered into spreadsheets which were imported into SPSS. Several data sets were made into graphs. The data appeared to be non-normal for many sets of data (some were bimodal, others displayed skew). Thus, the non-parametric Spearman's correlation test was used for data analysis. Tests at three spatial scales were run: point count set, study area, and all study areas combined. For point count sets, both surveys done for each set of point counts for the season were averaged together. For the study area level, the averaged point counts for each set were added to each other. For all study areas combined, all the study area numbers were added together. Abundance and richness were dependent variables, and were tested against the independent variables of distance from the batture, percentage of canopy cover, percentage of understory cover, and stem counts at the survey point. Tests were also performed to see how each of the independent variables correlated with one another using the Spearman's analysis. Three different groups of birds were tested in all abundance and richness tests: all birds, batture birds, and urban birds. Batture birds were defined as those that occur in higher densities in habitats provided by marsh, forest, riparian, etc. types of habitats. Urban birds were defined as those that had higher in density in urbanized habitats. Species were assigned using information from Kenn Kaufman's book *Lives of North American Birds* (1996) and the grouping was revised by Peter Yaukey, a researcher familiar with New Orleans' avifauna (Yaukey 2008). Unidentified birds, crows (*Corvus brachyrhynchos & ossifragus*), and grackles (*Quiscalus quiscaula* & *major*) were not classified by habitat. All bird species for which more than thirty individuals were detected were analyzed independently as well as in aggregate.

RESULTS

General Statistics

A total of 43 bird species were detected over the course of the study (Tables 1, 2 & 3). These included 22 species that generally use the batture more than residential areas (hereafter, *batture* species), 19 species widely found in residential areas (*urban* species), and 2 unidentified (unidentified crows and birds identified only as birds were not included in these numbers). Spring surveys tallied 34 species: 15 batture species, 17 urban species, and 2 unidentified species (again excluding unidentified crows and unidentified birds). In summer there were 31 species: 15 batture, 15 urban species, and 1 unidentified species. Eleven species found in spring were not recorded in the summer, and 9 found in summer did not appear in the spring.

Surveys recorded a total of 4117 individual birds, including 325 of batture and 3274 of urban species, and 518 of "unidentified" species or taxa. In the spring, 2241 individuals were detected, including 135 of batture and 1751 of urban species, and 335 unidentified. In the summer, the 1876 individuals included 190 of batture species, 1523 of urban species, and 163 unidentified.

A mean of 6.71 birds of 3.25 species was recorded at the seven batture points, compared to 7.28 birds of 3.33 species on the 136 urban residential points. During spring, 6.45 birds of 3.29 species were found at batture points, and 7.86 birds of 3.36 species were found at urban residential points. Summer points recorded a mean of 3.43 birds of 2.14 species in the batture and 6.67 birds of 3.30 species on urban residential points.

In spring, the study areas with the greatest species richness were St. Rose and Harahan (26 species) followed by Old Jefferson (23 species), and River Ridge (20 species). The number from Jefferson represents half as many sample points, so is artificially small. The number of individuals recorded per point per visit was greatest in Old Jefferson (19.37 individuals), followed by Harahan (18.95 individuals), St. Rose (16.90 individuals), and River Ridge (12.17 individuals). It should be noted that flocks of 30 or over were included in this number.

For the summer surveys, St. Rose had the greatest richness (25 species), then Harahan (22 species), then Old Jefferson (21 species), followed by River Ridge (19 species). Abundance at each site was as follows: Old Jefferson (16.21 individuals), St. Rose (15.83 individuals), then Harahan (11.42 individuals), and River Ridge (10.79 individuals).

Overall richness was found to be at 33 species in St. Rose, 31 species in Harahan, next was Jefferson at 30 species, and River Ridge was last with 25 species. Abundance per point count showed that Jefferson had the most birds (17.79 individuals) per point, then St. Rose (16.37 individuals), Harahan (15.18 individuals), and River Ridge (10.93).

In three of the four study areas, canopy cover was approximately 25 percent (table 4). The canopy at St. Rose was substantially more open. The coverage there was at about 15 percent. Stem counts in St. Rose were also the lowest of all the study areas, with under 10 trees per survey point. River Ridge was not far off from this number, averaging just fewer than 11 trees per survey point. Old Jefferson and Harahan had roughly 14 and 16 trees, respectively, per survey point. The percentage of understory cover at Old Jefferson, River Ridge, and Harahan was all near 11%, but again, St Rose had a slightly more open understory with cover slightly below 8%.

Common Name	**Scientific Name**	**Spring**	**Summer**	**Total**
Anhinga	*Anhinga anhinga*		1	1
American Robin	*Turdus migratorius*	4		4
Black Vulture	*Coragyps atratus*	1		1
Glossy Cowbird	*Molothrus ater*	2		2
Carolina Chickadee	*Poecile carolinensis*	70	107	177
Carolina Wren	*Thryothorus ludovicianus*	14	25	39
Cattle Egret	*Bubulcus ibis*	1		1
Coopers Hawk	*Accipiter cooperii*	1		1
Eastern Kingbird	*Tyrannus tyrannus*		5	5
Fish Crow	*Corvus ossifragus*	3	2	5
Great-crested Flycatcher	*Myiarchus crinitus*		25	25
House Wren	*Troglodytes aedon*	3		3
Little Blue Heron	*Egretta caerulea*		1	1
Red-bellied Woodpecker	*Melanerpes carolinus*	14	8	22
Red-headed Woodpecker	*Melanerpes erythrocephalus*		1	1
Red-shouldered Hawk	*Buteo lineatus*	1	1	2
Red-winged Blackbird	*Agelaius phoeniceus*	14	1	15
Ruby-throated Hummingbird	*Archilochus colubris*		3	3
Sharp-shinned Hawk	*Accipiter striatus*	2		2
Tufted Titmouse	*Baeolophus bicolor*	3	1	4
White Ibis	*Plegadis chihi*	2	1	3
Yellow-crowned Night Heron	*Nyctanassa violacea*		8	8
Total		135	190	325

Table 1. Species of batture birds present in study, presence in spring and summer, and total number.

Common Name	**Scientific Name**	**Spring**	**Summer**	**Total**
American Crow	*Corvus brachyrhynochos*	12	26	38
Blue Jay	*Cyanocitta cristata*	172	116	288
Cedar Waxwing	*Bombycilla cedrorum*	233		233
Chimney Swift	*Chaetura pelagic*		128	128
Downy Woodpecker	*Picoides pubescens*	44	42	86
Eurasian Collared Dove	*Streptopelia decaocto*	29	19	48
European Starling	*Sturnus vulgaris*	191	91	282
House Finch	*Carpodacus mexicanus*	15	25	40
House Sparrow	*Passer domesticus*	340	411	751
Loggerhead Shrike	*Lanius excubitor*		2	2
Mississippi Kite	*Ictinia mississippiensis*	8	62	70
Monk Parakeet	*Myiopsitta monachus*	8	4	12
Mourning Dove	*Zenaida macroura*	89	132	221
Northern Cardinal	*Cardinalis cardinalis*	49	48	97
Northern Mockingbird	*Mimus polyglottos*	217	315	532
Purple Martin	*Progne subis*	43	102	145
Ruby-crowned Kinglet	*Regulus calendula*	24		24
White-winged Dove	*Zenaida asiatica*	1		1
Yellow-rumped Warbler	*Dendroica coronate*	276		276
Total		1751	1523	3274

Table 2. Species of urban birds present in study, presence in spring and summer, and total number.

Common Name	**Scientific Name**	**Spring**	**Summer**	**Total**
Unidentified Bird	*Ave sp.*	38	62	100
Unidentified Crow	*Corvus brachyrynochos and ossifragus*	6		6
Unidentified Grackle	*Quiscalus quiscula and major*	309	101	410
Unidentified Hummingbird	*Trochilidae sp.*	2		2
Total		355	163	518

Table 3. Unidentified birds present in study, presence in spring and summer, and total number

Old Jefferson

Canopy	*Understory*	*Stem Count*
23.1579	11.8421	14.2222

River Ridge

Canopy	*Understory*	*Stem Count*
24.8810	10.8333	10.5250

Harahan

Canopy	*Understory*	*Stem Count*
26.6250	12.2500	15.5263

St. Rose

Canopy	*Understory*	*Stem Count*
15.2380	7.9761	9.8250

Table 4. Average percentage of survey point area covered by vegetation and average stem counts.

Spring

Canopy Cover

With seven point count sets, composites of the pairs of sets within Harahan, St. Rose, and River Ridge, and the grand composite, a total of eleven data sets are available for testing. Although these are not all independent of one another, I will report the number of these eleven that showed significant results for each variable as a general indication of the strength of patterns.

When data from all species of birds encountered were pooled (hereafter, *pooled* birds), it showed a strong trend to have greater species richness in areas of greater canopy coverage (table 5 and Maps A-D; Q-T). All three Harahan tests, the St. Rose study area, St. Rose point set B, and data from all study areas combined significantly had pooled birds having greater richness in areas with more canopy cover. This same trend was found in some urban bird tests, including the St. Rose study area and all study areas combined; it was marginally significantly present at Harahan. Batture birds also had greater richness in areas of greater canopy cover in the St. Rose study area, St. Rose point set B, and for all study areas combined.

When data from pooled birds were evaluated, there was little correlation between the percentage of canopy cover and abundance (table 6 and Maps E-H; Q-T). Only two tests of eleven returned a significant result, both showed a positive correlation between abundance and canopy cover.

One of the significant tests was for the Harahan study area, and the other was for Harahan point set B. Urban birds did not respond to canopy cover except in one test, the Harahan study area. This test showed a correlation between increasing levels of canopy cover and rising numbers of urban birds, though this correlation was weak. Urban species also showed a marginally significant response at Harahan A. Batture bird abundance increased in relation to higher percentages of canopy cover in the spring for the St. Rose study area, St. Rose point set B, and when data for all study areas was combined.

Stem Density

Richness in the bird population increased with higher stem counts in all significant tests during the spring (table 7 and Maps A-D; U-X). For pooled birds, greater richness was found in the test where data from all study areas were combined, in the Harahan study area, the Harahan point set B, and in the St. Rose point set B, and marginally significantly at River Ridge and River Ridge point set B. Urban birds showed greater richness in all the same tests as pooled birds minus the St. Rose point set B. It should be noted that the Harahan test was only weakly significant. There were some tests that were nearly significant, and supported the same trend. They were the River Ridge and St. Rose study areas, and River Ridge point set B. Batture birds were richer in the Harahan study area, the Harahan point set A, and for tests where data from all study areas was combined.

Stem density for pooled birds showed that they were more abundant where there were more trees in the Harahan study area, and for all study areas combined, and were marginally so at River Ridge point set B and Harahan point sets A and B (table 8 and Maps E-H; U-X). Strangely, this test showed a weaker correlation that either batture bird tests or urban bird tests on their own. Urban birds significantly showed greater abundance only when data from all study areas were combined, and marginally significantly at Harahan point set B. Batture birds had greater abundances in the Harahan study area, the Harahan point set A, and data when all study areas were combined. All of the significant batture bird tests were strongly so.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	Harahan *A*	Harahan *B*	St. Rose *All*	St. Rose *A*	St. Rose *B*
Spring												
All	*r*	0.23	0.12	0.02	0.03	0.09	0.49	0.51	0.49	0.43	0.19	0.65
Species	*p*	0.0052	0.6364	0.8971	0.8965	0.7117	0.0014	0.0173	0.0350	0.0044	0.4122	0.0014
Batture	*r*	0.25	0.24	-0.02	0.24	-0.15	0.24	0.34	0.20	0.42	0.33	0.52
Species	*p*	0.0021	0.3290	0.9001	0.2984	0.5028	0.1309	0.1325	0.4024	0.0058	0.1505	0.0157
Urban	*r*	0.23	0.28	0.05	0.12	0.07	0.29	0.29	0.30	0.31	0.21	0.37
Species	*p*	0.0053	0.2440	0.7716	0.6104	0.7736	0.0729	0.2095	0.2109	0.0440	0.3505	0.1022

Table 5. Spearman's correlation of bird richness with canopy cover, spring.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	Harahan *A*	Harahan *B*	St. Rose *All*	St. Rose *A*	St. Rose *B*
Spring												
All	*r*	0.11	0.08	-0.01	0.16	-0.05	0.40	0.29	0.49	0.19	-0.08	0.35
Species	*p*	0.2019	0.7517	0.9615	0.4769	0.8312	0.0109	0.1955	0.0332	0.2294	0.7321	0.1194
Batture	*r*	0.26	0.21	0.03	0.20	-0.05	0.20	0.30	0.15	0.43	0.33	0.54
Species	*p*	0.0014	0.3867	0.8744	0.3908	0.8270	0.2120	0.1820	0.5398	0.0040	0.1505	0.0119
Urban	*r*	0.13	0.04	-0.08	0.01	-0.04	0.31	0.37	0.34	0.13	0.02	0.18
Species	*p*	0.1163	0.8656	0.5995	0.9819	0.8599	0.0479	0.0953	0.1554	0.4164	0.9404	0.4365

Table 6. Spearman's correlation of bird abundance with canopy cover, spring.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	Harahan *A*	Harahan *B*	St. Rose *All*	St. Rose *A*	St. Rose *B*
Spring												
All	*r*	0.35	0.17	0.30	0.23	0.40	0.46	0.22	0.66	0.15	0.01	0.53
Species	*p*	0.0000	0.5003	0.0636	0.3307	0.0774	0.0036	0.3453	0.0027	0.3446	0.9682	0.0170
Batture	*r*	0.23	0.25	0.02	0.11	-0.10	0.47	0.57	0.32	0.13	-0.02	0.27
Species	*p*	0.0063	0.3156	0.8915	0.6331	0.6849	0.0030	0.0084	0.1966	0.4156	0.9462	0.2569
Urban	*r*	0.38	0.40	0.30	0.09	0.44	0.32	0.07	0.62	0.30	0.25	0.32
Species	*p*	0.0000	0.1017	0.0598	0.7101	0.0546	0.0491	0.7848	0.0060	0.0589	0.2809	0.1731

Table 7. Spearman's correlation of bird richness with stem counts, spring.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	Harahan *A*	Harahan *B*	St. Rose *All*	St. Rose *A*	St. Rose *B*
Spring												
All	*r*	*0.21*	*0.28*	*0.17*	*-0.16*	*0.40*	*0.41*	*0.41*	*0.43*	*-0.06*	*-0.34*	*0.27*
Species	*p*	*0.0162*	*0.2535*	*0.2833*	*0.4964*	*0.0786*	*0.0099*	*0.0757*	*0.0752*	*0.7159*	*0.1381*	*0.2494*
Batture	*r*	*0.25*	*0.27*	*0.04*	*0.13*	*-0.09*	*0.46*	*0.56*	*0.33*	*0.15*	*-0.02*	*0.30*
Species	*p*	*0. 0034*	*0.2858*	*0.7860*	*0.5919*	*0.7170*	*0.0033*	*0.0097*	*0.1850*	*0.3481*	*0.9462*	*0.1994*
Urban	*r*	*0.23*	*0.39*	*0.24*	*0.03*	*0.38*	*0.25*	*0.13*	*0.40*	*-0.09*	*-0.23*	*0.01*
Species	*p*	*0.0084*	*0.1056*	*0.1397*	*0.8939*	*0.1010*	*0.1284*	*0.5962*	*0.0973*	*0.5959*	*0.3300*	*0.9646*

Table 8. Spearman's correlation of bird abundance with stem counts, spring.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	Harahan *A*	Harahan *B*	St. Rose *All*	St. Rose *A*	St. Rose *B*
Spring												
All	*r*	0.25	-0.02	0.06	0.02	0.08	0.31	-0.07	0.60	0.54	0.25	0.53
Species	*p*	0.0026	0.9197	0.7080	0.9252	0.7283	0.0539	0.7781	0.0063	0.0002	0.2831	0.0135
Batture	*r*	0.30	0.47	0.01	-0.13	0.16	0.40	0.28	0.47	0.41	0.45	0.36
Species	*p*	0.0003	0.0450	0.9512	0.5657	0.4755	0.0112	0.2199	0.0410	0.0063	0.0395	0.1024
Urban	*r*	0.20	-0.08	0.11	0.11	0.16	0.12	-0.11	0.38	0.36	0.35	0.30
Species	*p*	0.0161	0.7581	0.4698	0.6217	0.4872	0.4617	0.6272	0.1108	0.0184	0.1192	0.1840

Table 9. Spearman's correlation of bird richness with understory vegetation, spring.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	Harahan *A*	Harahan *B*	St. Rose *All*	St. Rose *A*	St. Rose *B*
Spring												
All	*r*	0.27	0.07	0.24	0.37	0.17	0.39	0.17	0.58	0.39	0.46	0.47
Species	*p*	0.0010	0.7834	0.1314	0.0990	0.4556	0.0132	0.4741	0.0096	0.0115	0.0342	0.0301
Batture	*r*	0.29	0.46	-0.02	-0.21	0.21	0.40	0.32	0.37	0.41	0.45	0.37
Species	*p*	0.0005	0.0490	0.9092	0.3715	0.3569	0.0106	0.1567	0.1201	0.0068	0.0395	0.1024
Urban	*r*	0.17	-0.07	0.08	0.09	-0.14	0.11	-0.12	0.28	0.32	0.20	0.29
Species	*p*	0.0427	0.7622	0.6138	0.7007	0.8599	0.4847	0.5945	0.2395	0.0408	0.3816	0.2071

Table 10. Spearman's correlation of bird abundance with understory vegetation, spring.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	Harahan *A*	Harahan *B*	St. Rose *All*	St. Rose *A*	St. Rose *B*
Spring												
All	*r*	-0.03	0.05	-0.09	0.12	-0.25	-0.23	0.03	-0.51	0.19	0.11	0.28
Species	*p*	0.6962	0.8318	0.5822	0.6089	0.2841	0.1436	0.9037	0.0247	0.2333	0.6425	0.2177
Batture	*r*	-0.13	-0.13	-0.05	0.08	-0.16	-0.20	-0.28	-0.13	-0.20	-0.21	-0.19
Species	*p*	0.1100	0.6062	0.7655	0.7344	0.4867	0.2123	0.2189	0.6102	0.1997	0.3593	0.4081
Urban	*r*	0.02	0.19	-0.25	-0.38	-0.20	-0.11	0.09	-0.29	0.29	0.28	0.33
Species	*p*	0.8476	0.4476	0.1130	0.0894	0.3979	0.5181	0.7111	0.2253	0.0629	0.2124	0.1410

Table 11. Spearman's correlation of bird richness with distance from the batture, spring.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	Harahan *A*	Harahan *B*	St. Rose *All*	St. Rose *A*	St. Rose *B*
Spring												
All	*r*	-0.08	0.04	-0.32	-0.53	-0.19	-0.20	0.15	-0.59	0.18	-0.04	0.43
Species	*p*	0.3461	0.8775	0.0395	0.0126	0.4124	0.2240	0.5161	0.0080	0.2498	0.8733	0.0536
Batture	*r*	-0.12	-0.13	-0.07	0.06	-0.20	-0.09	-0.25	0.10	-0.20	-0.21	-0.19
Species	*p*	0.1638	0.6046	0.6773	0.7904	0.3737	0.5609	0.2704	0.6917	0.1987	0.3593	0.4045
Urban	*r*	0.03	0.27	-0.14	-0.35	-0.09	-0.03	0.33	-0.42	0.14	0.08	0.24
Species	*p*	0.7465	0.2588	0.3917	0.1150	0.6942	0.8500	0.1400	0.0739	0.3738	0.7183	0.2940

Table 12. Spearman's correlation of bird abundance with distance from the batture, spring.

Understory Vegetation

There was a greater richness in places with more understory cover for pooled birds in several tests (table 9 and Maps A-D; Y-BB). This was true for data from all study areas combined, the St. Rose study area, St. Rose point set B, Harahan point set B, and marginally significantly at the combined Harahan study area. Batture birds had greater richness in places with more understory vegetation when data for all study areas was combined, and in the St. Rose study area, St Rose point set A, Harahan study area, and Harahan point set B, and at Old Jefferson. Only two of these tests were strongly significant, the one for all study areas combined, and the St. Rose study area. Urban birds showed this trend when all study area data were combined and in the St. Rose study area, but the correlations were not strong.

When data for pooled birds were analyzed, the birds showed a strong tendency to have higher abundance in places with more understory vegetation, and the same was true of batture birds (table 10 and Maps E-H and Y-BB). All significant tests for pooled birds were positive, and the significant tests were the Harahan study area, Harahan point set B, all three St. Rose tests, and the test where all study area data wer combined; River Ridge point set A was also marginally significant. Significant batture bird tests showed that they preferred more understory vegetation. Tests showing this trend were the Old Jefferson study area, the Harahan study area, the St. Rose study area, St. Rose point set A, and data from all study areas combined. Urban birds did not have nearly as strong a reaction, but did have a positive correlation between abundance and understory vegetation in the St. Rose study area, and when data from all study areas were combined.

Distance

In all significant tests, richness declined with increasing distance from the batture (table 11 and Maps A-D). Richness of pooled bird species declined significantly farther from the batture at Harahan point set B, and urban birds did so marginally significantly at the Saint Rose and the River Ridge study areas.

Distance from the batture had less impact on bird abundance than did any vegetation variable (table 12 and Map E-H). Pooled birds showed a moderate correlation in the River Ridge study area and the River Ridge point set A, and a strong correlation for the Harahan B point set which was not carried over into the overall Harahan test. St. Rose point set B was nearly significant, but had a trend showing greater abundance further from the batture. Urban bird species showed a marginally significant decline in abundance farther from the batture at Harahan point set B.

Individual Species

Bird species that had at least thirty individuals detected during the surveys were analyzed in regards to their presence in conjunction with canopy cover, stem count, understory cover, and distance from the batture (table 13). Different species reacted differently to the independent variables. Blue Jays (*Cyanocitta cristata*) were found in places with higher percentages of canopy cover and higher stem counts, and marginally significantly in areas with more understory. Carolina Chickadees (*Poecile* *carolinensis*) preferred the same variables as Blue Jays (*Cyanocitta cristata*), except that the chickadees had a stronger correlation with stem counts. Cedar Waxwings (*Bombycilla cedrorum*) did not respond to any of the variables, except for a marginally significant positive relationship with stem count. Nor did European Starlings (*Sturnus vulgaris*), Mourning Doves (*Zenaida macroura;* but marginally significantly more abundant where there was more canop*y*), Northern Cardinals (*Cardinalis cardinalis*) or Northern Mockingbirds (*Mimus polyglottos*). Downy Woodpeckers (*Picoides pubescens*) strongly favored places with more canopy cover and understory vegetation, and moderately favored places with higher stem counts. Places with higher percentages of canopy cover were avoided by House Sparrows (*Passer domesticus*). Purple Martins (*Progne subis*) were more likely to be in places with higher stem counts, and had a marginally significant correlation with areas with more canopy cover. Grackles (*Quiscalus* sp.) avoided areas of increasing canopy cover, and this correlation was strong. Yellow-rumped Warblers (*Dendroica coronate*) had a strong preference for places with higher percentages of canopy cover, higher percentages of understory cover, and higher stem counts. No bird species had any correlations with distance from the batture, though the closer to the batture, the more unidentified birds there were. There were also more unidentified birds in areas with higher percentages of understory coverage.

Blue Jay	***Cyanocitta cristata***			
SPRING			SUMMER	
	R	*P*	*R*	*P*
Distance	-0.04	0.6657	0.06	0.4872
Canopy	0.21	0.0116	0.17	0.0484
Under	0.15	0.0781	0.19	0.0210
Stem Ct.	0.28	0.0011	0.14	0.1113

Carolina Chickadee	***Poecile carolinensis***			
SPRING			SUMMER	
	R	*P*	*R*	*P*
Distance	-0.02	0.8523	-0.10	0.2128
Canopy	0.18	0.0272	0.30	0.0003
Under	0.15	0.0838	0.26	0.0015
Stem Ct.	0.26	0.0024	0.22	0.0086

Cedar Waxwing	***Bombycilla Cedrorum***			
SPRING			SUMMER	
	R	*P*	*R*	*P*
Distance	0.08	0.3500		
Canopy	0.12	0.1387		
Under	0.03	0.7394		
Stem Ct.	0.15	0.0772		

Chimney Swift	***Chaetura Pelagic***			
SPRING			SUMMER	
	R	*P*	*R*	*P*
Distance			0.15	0.0700
Canopy			-0.02	0.8584
Under			-0.13	0.1362
Stem Ct.			0.00	0.9644

Downy Woodpecker	***Picoides pubescens***			
SPRING			SUMMER	
	R	*P*	*R*	*P*
Distance	-0.05	0.5972	0.05	0.5211
Canopy	0.22	0.0092	0.20	0.0167
Under	0.29	0.0005	0.10	0.2445
Stem Ct.	0.22	0.0103	-0.03	0.7443

European Starling	***Sturnus Vulgaris***			
SPRING			SUMMER	
	R	*P*	*R*	*P*
Distance	-0.01	0.9365	0.00	0.9641
Canopy	-0.10	0.2452	-0.17	0.0433
Under	-0.12	0.1538	-0.10	0.2129
Stem Ct.	-0.05	0.5535	-0.10	0.2357

House Sparrow	***Passer domesticus***			
SPRING			SUMMER	
	R	*P*	*R*	*P*
Distance	0.09	0.2804	0.06	0.4574
Canopy	-0.20	0.0163	-0.31	0.0002
Under	-0.13	0.1173	-0.07	0.4226
Stem Ct.	-0.13	0.1235	-0.06	0.5030

Mississippi Kite	***Ictinia mississippiensis***			
SPRING			SUMMER	
	R	*P*	*R*	*P*
Distance			0.19	0.0252
Canopy			0.18	0.0333
Under			0.11	0.1763
Stem Ct.			0.06	0.4635

Mourning Dove	***Zenaida macroura***			
SPRING			SUMMER	
	R	*P*	*R*	*p*
Distance	-0.12	0.1571	0.02	0.8070
Canopy	0.15	0.0766	-0.05	0.5515
Under	0.05	0.5530	-0.03	0.6914
Stem Ct.	0.09	0.2920	-0.12	0.1533

Northern Cardinal	***Cardinalis cardinalis***			
SPRING		SUMMER		
	R	*P*	*R*	*p*
Distance	-0.03	0.6945	-0.17	0.0445
Canopy	0.01	0.8877	0.00	0.9920
Under	0.09	0.2842	0.05	0.5816
Stem Ct.	0.11	0.2050	-0.12	0.1530

Northern Mockingbird	***Mimus polyglottos***			
SPRING		SUMMER		
	R	*P*	*R*	*p*
Distance	0.12	0.1592	0.07	0.4089
Canopy	-0.06	0.4575	0.10	0.2512
Under	0.09	0.2620	0.10	0.2138
Stem Ct.	0.12	0.1683	0.13	0.1261

Purple Martin	***Progne subis***			
SPRING		SUMMER		
	R	*P*	*R*	*p*
Distance	0.02	0.8459	0.06	0.4438
Canopy	0.16	0.0613	0.06	0.5045
Under	0.05	0.5844	-.0.02	0.7901
Stem Ct.	0.19	0.0251	0.06	0.5725

Unidentified Bird				
SPRING		SUMMER		
	R	*P*	*R*	*p*
Distance	-0.24	0.0040	-0.01	0.8675
Canopy	0.15	0.0769	0.22	0.0072
Under	0.27	0.0010	0.23	0.0063
Stem Ct.	0.05	0.5926	0.13	0.1334

Unidentified Grackle	***Corvus brachyrynochos and ossifragus***			
SPRING		SUMMER		
	R	*P*	*R*	*p*
Distance	-0.12	0.1481	-0.15	0.0832
Canopy	-0.23	0.0065	-0.26	0.0020
Under	0.02	0.8446	-0.07	0.3864
Stem Ct.	-0.09	0.3098	-0.15	0.0763

Yellow-rumped Warbler	***Dendroica coronate***			
SPRING		SUMMER		
	R	*P*	*R*	*p*
Distance	-0.06	0.4593		
Canopy	0.42	0.0000		
Under	0.22	0.0086		
Stem Ct.	0.35	0.0000		

Table 13. Spearman's correlation of species with over 30 detections as they correlate to independent variables.

Summer

Trees

When summer richness was evaluated in conjunction with canopy cover, significant positive relationships were detected for all species pooled at Saint Rose point set B, and for urban species at the same point set (Table 14 and Maps I-L; Q-T). Batture species were associated with more canopy cover significantly across the composite of all sites, at Saint Rose, and at its two individual point sets.

Urban birds during the summer had no correlation to canopy cover as it relates to abundance for any tests in any of the study areas (Table 15 and Maps M-P; Q-T). Pooled birds also did not show any correlations. Interestingly, pooled birds in the summer had no significant correlations at all, regardless of study area or independent variable. Batture birds did respond to canopy cover in the summer, and all significant tests were strongly so. Both point sets in the St. Rose study area had an increasing abundance of birds with increasing percentages of canopy cover. This was also true for batture birds when data from all study areas were combined.

Stem Density

Stem density in conjunction with richness had largely the same significant tests as stem density in conjunction with abundance (Tables 16 and 17 and Maps I-P; U-X). Batture bird richness was greater where there were more trees in the St. Rose study area, St. Rose point set A, and data from all study areas combined. This was also marginally significantly true of pooled birds at Saint Rose point set B.

Only batture birds had any significant relationships between stem density and abundance for the summer surveys (table17 and Map L). Three tests found batture birds to be more prevalent in places of higher stem density, St. Rose study area, St. Rose point set A, and data from all study areas combined.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	Harahan *A*	Harahan *B*	St. Rose *All*	St. Rose *A*	St. Rose *B*
Summer												
All	r	0.02	0.05	-0.12	0.00	-0.21	0.07	0.13	0.02	0.17	0.01	0.38
Species	p	0.8391	0.8487	0.4517	0.9898	0.3681	0.6712	0.5847	0.9209	0.2923	0.9817	0.0870
Batture	r	0.24	-0.04	-0.02	0.00	-0.06	0.20	0.26	0.12	0.55	0.68	0.52
Species	p	0.0034	0.8786	0.9248	1.0000	0.8075	0.2182	0.2488	0.6350	0.0001	0.0007	0.0163
Urban	r	0.03	0.13	-0.16	-0.02	-0.31	-0.11	-0.05	-0.20	0.15	-0.32	0.40
Species	p	0.7214	0.5868	0.2970	0.9398	0.1774	0.5108	0.8281	0.4194	0.3588	0.1569	0.0760

Table 14. Spearman’s correlation of bird richness with canopy cover, summer.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	Harahan *A*	Harahan *B*	St. Rose *All*	St. Rose *A*	St. Rose *B*
Summer												
All	*r*	-0.07	0.01	-0.08	0.00	-0.13	0.05	0.12	-0.04	0.03	0.09	0.02
Species	*p*	0.4302	0.9756	0.6148	0.9831	0.5598	0.7710	0.6101	0.8685	0.8131	0.6998	0.9440
Batture	*r*	0.25	-0.07	0.01	-0.02	-0.03	0.20	0.31	0.08	0.58	0.64	0.59
Species	*p*	0.0025	0.6947	0.9539	0.9248	0.8966	0.2057	0.1769	0.7327	0.5751	0.0016	0.0047
Urban	*r*	-0.13	-0.06	-0.17	-0.02	-0.25	-0.03	-0.07	-0.06	-0.11	-0.33	0.02
Species	*p*	0.1229	0.8188	0.2925	0.9189	0.2762	0.8360	0.7764	0.7955	0.4996	0.1490	0.9160

Table 15. Spearman’s correlation of bird abundance with canopy cover, summer.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	Harahan *A*	Harahan *B*	St. Rose *All*	St. Rose *A*	St. Rose *B*
Summer												
All	*r*	0.06	0.22	0.05	0.04	0.00	0.01	0.18	0.12	0.16	0.01	0.40
Species	*p*	0.4529	0.3855	0.7784	0.8524	0.9911	0.5341	0.4448	0.6306	0.3146	0.9536	0.0813
Batture	*r*	0.18	-0.17	0.05	0.05	0.08	0.20	0.23	0.25	0.34	0.53	0.35
Species	*p*	0.0373	0.4953	0.7485	0.8389	0.7363	0.2402	0.3325	0.3086	0.0313	0.0169	0.1340
Urban	*r*	0.02	0.26	-0.07	-0.06	-0.17	-0.08	0.08	-0.32	0.19	-0.03	0.34
Species	*p*	0.8417	0.3011	0.6588	0.8103	0.4743	0.6132	0.7508	0.1897	0.2414	0.8904	0.1378

Table 16. Spearman's correlation of bird richness with stem counts, summer.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	River Ridge *A*	River Ridge *B*	St. Rose *All*	River Ridge *A*	River Ridge *B*
Summer												
All	*r*	0.04	0.00	0.12	0.00	0.24	0.05	0.27	0.00	0.04	-0.08	0.18
Species	*p*	0.6260	0.9951	0.4577	0.9886	0.3026	0.7538	0.2430	0.9918	0.8087	0.7275	0.4495
Batture	*r*	0.20	-0.20	0.09	0.04	0.22	0.24	0.36	0.24	0.37	0.53	0.35
Species	*p*	0.0208	0.4283	0.5816	0.8564	0.3627	0.1399	0.1245	0.3407	0.0205	0.0165	0.1268
Urban	*r*	0.00	0.06	0.09	-0.03	0.20	0.01	0.15	-0.07	-0.05	-0.38	0.22
Species	*p*	0.9584	0.8123	0.6012	0.9092	0.3878	0.9691	0.5175	0.7785	0.7817	0.1006	0.3539

Table 17. Spearman's correlation of bird abundance with stem counts, summer.

Understory Vegetation

Pooled bird species were marginally significantly greater in richness in areas with greater understory cover at River Ridge and River Ridge point set A (Table 18 and Maps I-L; Y-BB). However, more consistent results in this direction were obtained pertaining to batture birds. Moderate correlations showing this relationship were found for the River Ridge study area, River Ridge point set A, the Harahan study area, Harahan point set A (this correlation was weak, not moderate), the St. Rose study area, St. Rose point set A, and marginally significantly from Old Jefferson. A strong relationship was found between increasing batture bird richness and increasing understory vegetation for data from all study areas combined.

Batture bird abundance was very responsive to understory vegetation, but urban birds and data from pooled birds was not, although pooled birds did have marginally significant test results at River Ridge point set A (Table 19 and Maps M-P; Y-BB). Two study areas, Harahan and St. Rose, had moderate correlations showing that more batture birds were found in areas with greater percentages of understory cover. River Ridge and St. Rose point set A had marginally significant results in the same direction. Two point sets, Harahan A and River Ridge A, showed the same correlation. For data from all study areas combined, there was a strong correlation linking higher abundances of batture birds to more understory cover.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	Harahan *A*	Harahan *B*	St. Rose *All*	St. Rose *A*	St. Rose *B*
Summer												
All	*r*	0.13	-0.11	0.28	0.40	0.18	0.12	0.29	0.01	0.18	0.09	0.32
Species	*p*	0.1205	0.6408	0.0718	0.0757	0.4294	0.4482	0.2011	0.9679	0.2495	0.7066	0.1639
Batture	*r*	0.34	0.42	0.34	0.53	0.14	0.33	0.43	0.28	0.34	0.45	0.29
Species	*p*	0.0000	0.0771	0.0301	0.0131	0.5572	0.0347	0.0497	0.2436	0.0272	0.0420	0.2045
Urban	*r*	0.02	-0.19	0.21	0.32	0.14	-0.12	0.11	-0.35	-0.02	-0.31	0.20
Species	*p*	0.8380	0.4296	0.1804	0.1617	0.5576	0.4612	0.6421	0.1477	0.8993	0.1778	0.3963

Table 18. Spearman's correlation of bird richness with understory vegetation, summer.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	Harahan *A*	Harahan *B*	St. Rose *All*	St. Rose *A*	St. Rose *B*
Summer												
All	*r*	0.05	-0.10	0.26	0.37	0.14	-0.03	0.23	-0.25	0.12	0.07	0.22
Species	*p*	0.5252	0.6825	0.1031	0.0959	0.5392	0.8753	0.3221	0.2924	0.4641	0.7688	0.3329
Batture	*r*	0.32	0.39	0.30	0.53	0.09	0.32	0.45	0.22	0.32	0.37	0.35
Species	*p*	0.0001	0.1004	0.0513	0.0144	0.7116	0.0455	0.0423	0.3557	0.0367	0.0946	0.1223
Urban	*r*	-0.04	-0.23	0.20	0.29	0.13	-0.15	0.04	-0.32	-0.05	-0.29	0.19
Species	*p*	0.6031	0.3537	0.2016	0.1984	0.5849	0.3655	0.8595	0.1757	0.7734	0.1987	0.4147

Table 19. Spearman's correlation of bird abundance with understory vegetation, summer.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	Harahan *A*	Harahan *B*	St. Rose *All*	St. Rose *A*	St. Rose *B*
Summer												
All Species	*r*	0.10	0.35	0.07	-0.07	0.23	0.09	0.03	0.17	0.04	-0.09	0.13
	p	0.2506	0.1445	0.6384	0.0687	0.3915	0.5749	0.8924	0.4860	0.7954	0.7085	0.5743
Batture Species	*r*	-0.17	-0.14	-0.23	-0.06	-0.44	-0.24	-0.35	-0.13	-0.08	0.02	-0.16
	p	0.0391	0.5635	0.1346	0.8000	0.0458	0.1306	0.1178	0.6046	0.5956	0.9414	0.4981
Urban Species	*r*	0.23	0.39	0.30	0.01	0.68	0.27	0.24	0.39	0.06	-0.14	0.17
	p	0.0068	0.0994	0.0506	0.9504	0.0007	0.0911	0.2952	0.0979	0.7147	0.5502	0.4721

Table 20. Spearman's correlation of bird richness with distance from the batture, summer.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	Harahan *A*	Harahan *B*	St. Rose *All*	St. Rose *A*	St. Rose *B*
Summer												
All Species	*r*	0.03	0.13	0.06	-0.13	0.18	0.02	0.26	-0.14	0.02	0.00	0.04
	p	0.6907	0.6003	0.7196	0.5890	0.4402	0.8901	0.2579	0.5748	0.8895	0.9978	0.8644
Batture Species	*r*	-0.13	-0.15	-0.19	-0.10	-0.27	-0.19	-0.26	-0.09	0.00	0.13	-0.12
	p	0.1205	0.5336	0.2239	0.6639	0.2374	0.2461	0.2483	0.7264	0.9893	0.5646	0.6008
Urban Species	*r*	0.10	0.28	0.11	-0.05	0.26	0.11	0.36	-0.17	0.01	0.02	0.00
	p	0.2148	0.2471	0.4784	0.8267	0.2538	0.5061	0.1128	0.4958	0.9389	0.9328	1.0000

Table 21. Spearman's correlation of bird abundance with distance from the batture, summer.

Distance

Richness and distance from the batture had a few significant correlations (table 20). Pooled bird richness was marginally significantly lower farther from the batture at River Ridge point set A. Batture birds had two significant tests. The River Ridge point set B and data from all study areas combined showed that batture birds had a decrease in richness the further away from the batture the surveys were. It should be noted that the River Ridge point set B test was weakly significant. The reverse was true for two urban bird tests. The same two tests (River Ridge point set B and data from all study areas combined) showed strong trends for urban bird richness to increase the further away from the batture the surveys were conducted; marginally significant results were also obtained at Old Jefferson, River Ridge point set A, Harahan, and Harahan point set B, all in the same direction. For the summer survey, distance from the batture was not significantly correlated with abundance in any tests (table 21).

Individual Species

During the summer, Blue Jays (*Cyanocitta cristata*) showed a weak preference for areas with more canopy cover and more understory vegetation (table 13). Carolina Chickadees (*Poecile carolinensis*) showed a strong preference for areas with more canopy cover, more understory cover, and higher stem counts. Mourning Doves (*Zenaida macroura*), Northern Mockingbirds (*Mimus polyglottos*) and Purple Martins (*Progne subis*) had no habitat preferences. Downy Woodpeckers (*Picoides pubescens*) had a preference for areas with increasing canopy cover. European Starlings (*Sturnus vulgaris*) and House Sparrows (*Passer domesticus*) avoided areas with increasing canopy cover, and the

House Sparrow correlation was strong. Mississippi Kites (*Ictinia mississippiensis*) showed a preference for locations further away from the batture, and for areas with more canopy cover. Chimney Swifts (*Chaetura pelagic*) were also marginally significantly more common farther from the batture. Northern Cardinals (*Cardinalis cardinalis*) showed a slight preference to be closer to the batture. Grackles (*Quiscalus* sp.) strongly sought out areas of little canopy cover, and had marginally significant trends toward lower counts at sites with more tree stems and that were farther from the batture. There was a strong correlation between increasing canopy cover and increasing understory vegetation and unidentified birds.

Independent Variables

Many of the independents correlated with one another (table 22 and Maps Q-BB). Not surprisingly, canopy cover and stem count fall into this category. The higher the stem count, the more canopy cover there was for all Harahan and St. Rose tests, and also for tests where data from all study areas was combined. Canopy cover and understory cover are also positively correlated for the Harahan, River Ridge, and St. Rose tests study area tests, River Ridge point set A (slightly significant), Harahan point set B, St. Rose point set A, and for the test where data from all study areas was combined. Canopy cover and distance from the batture, however, had no correlation to one another. Distance from the batture and stem counts had two significant tests. More trees were located further away from the batture in the St. Rose study area (however, this correlation was weak), and for the River Ridge A point set. The Old Jefferson study area nearly had a significant correlation supporting the same trend. Distance from the batture and understory vegetation had four correlations. The Harahan study area and Harahan point set B, River Ridge point set A, and data from all study areas combined showed that there was more understory vegetation closer to the batture. Lastly, stem counts and understory vegetation also increased in conjunction with one another in the Harahan study area, Harahan point set B, the St. Rose study area, and for data from all study areas combined.

		All Areas	Jefferson	River Ridge *All*	River Ridge *A*	River Ridge *B*	Harahan *All*	Harahan *A*	Harahan *B*	St. Rose *All*	St. Rose *A*	St. Rose *B*
Understory & Canopy	*r*	0.46	0.20	0.33	0.44	0.22	0.47	0.17	0.73	0.43	0.56	0.36
	p	0.0000	0.4163	0.0317	0.0468	0.3457	0.0023	0.4707	0.0004	0.0050	0.0087	0.1137
Understory & Stem Ct.	*r*	0.26	0.21	-0.07	-0.16	0.03	0.46	0.21	0.65	0.34	0.31	0.25
	p	0.0019	0.3968	0.6722	0.5074	0.9145	0.0035	0.3731	0.0039	0.0332	0.1779	0.2783
Stem Ct. & Canopy	*r*	0.45	0.26	0.22	0.37	0.09	0.49	0.60	0.49	0.35	0.70	0.75
	p	0.0000	0.3029	0.1727	0.1118	0.6932	0.0018	0.0052	0.0399	0.0247	0.0007	0.0001
Canopy & Distance	*r*	-0.08	0.14	-0.13	-0.14	-0.13	-0.16	-0.03	-0.28	0.00	-0.09	0.03
	p	0.3405	0.5661	0.4273	0.5446	0.5720	0.3356	0.9028	0.2499	0.9940	0.6968	0.8931
Understory & Distance	*r*	-0.21	-0.07	-0.20	-0.52	0.09	-0.33	-0.13	-0.49	-0.09	-0.40	0.22
	p	0.0122	0.7801	0.1978	0.0152	0.7080	0.0396	0.5624	0.0321	0.5807	0.0755	0.3429
Stem Ct. & Distance	*r*	0.16	0.46	0.12	0.51	-0.22	0.04	0.39	-0.35	0.31	0.25	0.23
	p	0.0584	0.0565	0.4652	0.0209	0.3512	0.8079	0.0913	0.1524	0.0494	0.2879	0.3238

Table 22. Spearman's correlation for correlations between independent variables

DISCUSSION

The impact of distance from the batture on the birds was not as strong as was expected, though it did have a positive influence on batture bird richness during the summer, and a negative influence on urban bird richness. Vegetation variables were much more important to bird populations. Distance from the batture very rarely had anything to do with the numbers of birds in an area. Only River Ridge had significant results for distance and abundance, and this was not strong enough to be carried over into the all study areas combined test. Two species, Mississippi Kites and Northern Cardinals were found farther away and closer to the batture respectively, during the summer. Unidentified birds were more likely to be found nearer the batture during the spring. Other than this, bird abundance did not clearly respond to distance from the batture.

Distance was more influential on bird richness than abundance in summer than spring. Batture bird populations were more species rich nearer the batture, whereas urban bird richness was greatest further away from the batture. These two populations cancelled each other out for the pooled birds test (in fact, no test for all species of birds combined in the summer had any significant results). It is possible that the buffer in the present study was not wide enough to have much influence on nearby residential areas' bird populations. Bird abundance stayed static regardless of distance from the batture.

There may be several other reasons that distance was not a more important variable for bird populations. Though the batture is nearly as undisturbed by humans as is possible for areas within the city, it is still disturbed. Many people jog or bike along the levee bordering the batture, and the grassy area on either side of the levee itself is a popular place to bring dogs for walks. People sometimes venture into the batture itself. This may prove to be disturbing to birds (Burhans and Thompson 2006; Chace and Walsh 2009; Miller et al. 2003). Birds within the batture may have been more difficult to detect, due to the more abundant foliage. On more than one occasion, I flushed birds as I neared my survey point, and those birds generally did not return during my five minute survey period. Birds in the batture seemed particularly nervous, and some birds that did not fly away at my approach may have opted to remain still and silent until I departed. The batture may have been too narrow to result in stronger results. The mowed, grassy levee area (all points 50 meters away from the batture were located in this area) was not frequented by birds and may have been countering some impact the batture may have had on the test results. Indeed, the grassy levee area had some of the fewest birds detected of all the surveys. Lastly, it may be that my 1 km buffer into the residential neighborhood was too large since buffers of around 200 meters were found to be the most effective at detecting changes within bird populations attracted to native vegetation (Clergeau, Jokimaki and Savard 2001). Examination of finer scale changes within the first few hundred meters might be in order.

If the batture is looked at in a different light, as part of the vegetative variables, then it could be viewed as a beneficial habitat for birds, especially batture birds. Places with more vegetation had a greater abundance and richness of birds in this study. Urban bird responses to vegetation were not strong as batture birds, but in spring tests with data from all study areas combined, urban birds responded positively to all vegetative variables in at least some tests. Interestingly, in the summer, urban birds made no clear responses to any of the vegetative variables as a group. They were found to be very inclined to have greater richness further away from the batture. This indicates that urban birds use the habitat differently during the different seasons. For some reason, they cease to seek out vegetation in the summer months. Indeed, though most are not significant, many of the summer tests have a negative relationship between urban birds and vegetation. Perhaps the urban birds are avoiding vegetation to a very limited degree. It may be that bird habits change during nesting season, causing the urban birds to move to less vegetated areas. Plants during the spring survey had far fewer leaves than they did in the summer, and perhaps this contributes to the patterns of urban birds. There are some migratory species included in the urban bird guild, and the turnover in the species may have impacted the bird distribution as well, since different species could have different preferences.

Batture birds consistently preferred areas with vegetation in both seasons. Abundance and richness were always greater in areas of greater vegetation. It should be noted that over half of the batture birds were Carolina Chickadees, and they were by far the dominant batture bird species. Thus, the battue bird trends are heavily influenced by chickadees. Batture birds appear to be more dependent on vegetation than birds in the urban guild. In the spring, every vegetation variable was related strongly to batture birds in at least some test. The summer surveys show the batture birds having the same preferences, except for they are not as strongly linked with higher stem counts as they were in the spring. Batture birds also had greater species richness nearer the batture in the summer. Carolina Chickadees were shown to be strongly attracted to areas of more vegetation when tested on their own. Tests would need to be done on batture birds with Carolina Chickadees removed in order to see how the remainder of the birds reacted to the independent variables, though it is very likely that the trends would be similar. Most tests involving vegetation and batture birds showed that batture birds had stronger relationships with the vegetation than did chickadees alone. It appears that the batture does have a small positive influence on batture bird populations (and perhaps a negative one on urban birds, but more data is needed to support this), but even more important is having large percentages of vegetative cover and trees in the area. The batture provides this type of habitat, along with people who grow trees, bushes, and other types of plants in their lawns. Batture bird preferences at each season may be due to changes in the demands of raising young, differences in the species present in the different seasons, different levels of foliage being present during the different months, or another factor that I have not yet noticed.

The most dramatic changes between the seasons occurred with pooled birds. Pooled birds favored higher amounts of all types of vegetation in the spring, but in the summer there were no significant relationships between pooled birds and any of the independent variables. There were only ten percent as many batture birds as urban birds, so batture birds and unidentified birds were also much smaller in number than urban birds (it is possible that most unidentified birds would fall into the urban bird classification, as will be discussed later in the paper). Since urban birds did not seek out (and may have avoided) areas with lots of vegetation, pooled birds was heavily influenced by this. Additionally, batture birds, though a much smaller group numerically, sought vegetation. The fact that the two guilds of bird were doing divergent things contributed to the lack of any significant tests at all for pooled birds in the summer. In the spring, however, both guilds sought vegetation and so the pooled bird results showed this as well.

Blue Jays were categorized as urban birds. These birds always preferred areas with greater canopy cover regardless of season. During the spring, the jays were found in areas of higher stem counts. In the summer they had no relationship with stem counts, but were more likely to be found in places with more understory vegetation. Blue Jays are often found in conjunction with oak trees

(Cornell 2012; Kaufmann 1996). Live Oak (*Quercus virginiana*) is a very popular tree in New Orleans, and these trees were found in great number in the study areas. This may help explain the high abundance of Blue Jays and their correlation with trees.

Carolina Chickadees were the only member of the batture guild for which over thirty individuals were detected. Not surprisingly, they were closely linked to vegetation but stem counts were the most important variable. In the spring, these birds had a tendency to be found in places with lots of canopy cover, but had stronger ties with high stem counts. Summer birds had a strong tendency to be found in places that had more canopy, understory vegetation, and high stem counts. Since Carolina Chickadees are primarily gleaning foragers, their close tie to vegetation was expected. They are not opposed to visiting bird feeders, however (Oberholser 1938). The chickadees may have needed to be in vegetated areas more during the summer because of nestlings, and the food demands they placed on the parents.

Cedar Waxwings were one of the most numerous birds in the survey. They are a highly social species, and form large flocks. This may help to explain why these birds had no correlation with any of the independent variables. While many birds were detected, they were only detected in a few places. As a result, I ended up with only a few unique data points to use in evaluation, and so may have needed to encounter more flocks to get an accurate evaluation. Other possibilities exist. It could be that these waxwing flocks were seeking food sources since they are frequently found in plants with berries and other foodstuffs (Cornell 2012; Kauffman 1996). If I had looked at how food sources impacted bird distribution, a relationship may have been found showing that waxwings had a relationship with berry bearing plants. Another study has found certain species to be attracted to berrying plants (Melles, Glen & Martin, Glen & Martin 2003). It has been noted that there seems to be no pattern to predicting where waxwing flocks may decide to be, as "it cannot be depended on always to appear at times when it should, and it often is absent at times and from places which seems entirely favorable" (Oberholser 1938). Cedar Waxwings were not present in the summer, which they spend farther north.

Chimney Swifts had no ties with any of the vegetation variables. This is not surprising. Swifts are unable to perch, and so would not use vegetation for cover. They are aerial insectivores, and would most likely be found in the places with the most insects. These birds nest and roost on buildings, especially chimneys which are the closest thing to large, dead and hollowed out trees, their original roosting/nesting habitat (Cornell 2012; Kauffman 1996). It could also be that these birds would be found in places where buildings had chimneys, especially chimneys that were out of use. This species was not present in the spring.

Downy Woodpeckers were most likely to be found in association with canopy cover. This association was strong in the spring and moderate in the summer. There were no other associations in the summer, but in the spring these birds were found in conjunction with understory vegetation and with high stem counts. This relationship may be due to the food source for woodpeckers. In addition to foraging in trees for insects and larvae, these small woodpeckers also seek out galls in plants that contain insect larvae (Cornell 2012; Kauffman 1996).

European Starlings were unresponsive to variables in the spring. The summer showed that this species was avoiding the areas with canopy cover. Starlings are a classic urban bird – an exotic, omnivorous ground forager, found in close association with humans and their buildings. It is not surprising that these birds did not seek vegetation, and even avoided it to some degree (Cornell 2012; Kauffman 1996).

House Sparrows were the most numerous birds in the survey. These birds, like the starling, avoided places with large percentages of canopy cover. The difference is that House Sparrows did so more strongly. They avoided canopy cover during both seasons, and did so to a strong degree in the summer. House Sparrows, too, are classic urban birds that prefer to live in cities and are not found away from humans and their structures. (Cornell 2012; Kauffman 1996) These birds were strongly attracted to bird feeders in the study area.

Mississippi Kites were in the study area during the spring and summer, but many birds were still migrating in the spring and this species did not meet the thirty individuals mark (Lowery 1974). They were interesting in that they had a relationship with the batture. They were more likely to be found further away from it. This was surprising because these birds are reported to prefer living along bodies of water and specifically in the batture (Cornell 2012; Kauffman 1996; Lowery 1974; Oberholser 1938). It is possible that these birds have territories that fall largely outside of the batture.   This species also preferred to be in places with more canopy cover.

Two species of birds native to the area showed no preferences for any parts of the study area. These were Mourning Doves and Northern Mockingbirds. Both of these species are common in urban settings and in natural ones as well. Both forage on the ground, though the Mourning Dove eats primarily seeds, while the Mockingbird appears to eat everything (Cornell 2012). Mourning Doves are fairly flexible in nest placement, and appear to be able to live anywhere excepting deep or dense woods (Cornell 2012; Oberholser 1938). Mockingbirds were the second most numerous species detected during the survey. Mockingbirds are fairly obvious birds, not prone to hide, and occasionally a Mockingbird would alert me to the presence of another bird when it would aggressively chase the "intruder" out of its territory. Like the Mourning Dove, Mockingbirds seem to be able to live anywhere save thick forests (Oberholser 1938). Their preferred habitat is scrubby bushes, and there is a possibility that this species is in a slow numerical decline due to loss of that habitat (Cornell 2012). However, they appear to be expanding their range and this is likely being aided by human factors (Kaufmann 1996).

Northern Cardinals showed no relationships in the spring. In the summer, though, these birds were unique in that they showed a slight preference to be closer to the batture. No other bird species clearly demonstrated this trend. Only the Mississippi Kite had a relationship with the batture, and it was the opposite relationship. Perhaps the batture was beneficial to this bird in some way, or there may have been some factor drawing the birds to this area that was not considered. Northern Cardinals are known to like the edges of forests and to nest in dense understory vegetation (Cornell 2012). This may have attracted them to the batture. Across the United States it may be that this species has been able to expand its range because of human city building activities (Cornell 2012).

Purple Martins showed a preference for higher stem counts in the spring, but this was not true during the summer. During the summer, these birds may have been raising young, and so were not able to perch as much as they had in the spring. Purple Martins are another native bird that is strongly attracted to cities. It is thought that most of the population in the Eastern United States now nests in human created structures (Cornell 2012). Purple Martin populations are declining in the United States, possibly due to competition with European Starlings for nesting sites (Kaufmann 1996).

Grackles were the third most numerous bird detected in the survey. Most of the grackles were Common Grackles and would have been classified as urban birds. This was based on appearance, behavior, and habitat of the birds. These birds strongly avoided places with high percentages of canopy cover regardless of season. Common Grackles are reported to frequent areas with trees next to open tracts of land (Kaufmann 1996), and this seemed to be the case in this study. Some of the places these birds frequented the most were a few sites in St. Rose where there were a few tall trees, or a line of tall trees next to areas of practically no vegetation. Occasionally, these birds formed flocks that were so large as to be eliminated from the abundance tests in this study.

Yellow-rumped Warblers showed strong ties to all types of vegetation. They were only present during the spring. Perhaps these little birds were so frequently found in vegetation because they were busily foraging to put on weight for their migration to their northern habitat. Since these birds are gleaning foragers and berry eaters, they are dependent of vegetation for their food. Occasionally, though, they do eat seeds and even seeds from feeders (Cornell 2012). These small birds are found most anywhere there is a bush or a tree (Oberholser 1938). These birds do show some plasticity in feeding habits and are not terribly picky about habitat, which may help explain why they do well in cities.

I was most likely to have more difficulty identifying birds in areas with more vegetation. This is where most unidentified birds were found. There were more unidentified birds in the summer than in the spring, which is not surprising since the vegetation had more foliage during the summer surveys. Unidentified birds were also more likely to be found closer to the batture during the spring. There was also a correlation showing there to be more understory vegetation nearer the batture. Perhaps this helps explain why more birds were near the batture. It is also possible that I was subconsciously more willing to mark down a bird as unidentified nearer the batture since I hoped to find more birds there. On a side note, it is interesting that no Rock Pigeons were detected during the survey. There were a very few that flew overhead during the survey (generally at points closest to Jefferson Highway), but none landed or appeared to be doing anything more than passing over the survey area.

The study areas themselves were different from one another. The Old Jefferson study area was bordered by the most urban areas out of all the study sites. There are two large and busy highways nearby that are bordered with commercial and industrial properties. Jefferson Highway is also fairly commercial at this location. Interestingly, this small area had the second greatest average stem counts and understory vegetation. Though it was ranked third in canopy cover, it was not that far off from the two sites ranked above it. Birds in this area did not respond much to any of the independent variables. Some might think to blame this on the small sample size of the study area, but other point count sets had the same amount of data points as the Old Jefferson study area, and had more significant tests. It was a fairly homogeneous study area when one excludes the Jefferson Highway, as was done in this study. That is to say, most of the homes and lots were the same size and vegetation appeared to be spread fairly evenly throughout the area. Judging from the architecture, most of the homes appeared to have been built around the same time, and this is the oldest of all the neighborhoods in the study.

Perhaps these factors play into the lack of significant results in this location. This could also be due to the urbanized nature of the places surrounding the Old Jefferson study area.

St. Rose was the most unique of the study sites. It was surrounded by quite a bit of wetlands and the least urban of any of the areas, though it did have a refinery on the eastern border. There was a great deal of variety in lot sizes, vegetative cover, and even wealth of home owners. Each street in St. Rose had its own flavor. One street was filled with new homes that had large lots and little vegetation. Another street had tiny lots that were nearly filled with the house or trailer found thereon. Yet a third street was inhabited by middle income homes that were situated in lots covered with vegetation. St. Rose also had the least vegetation out of all the study areas, and the further over to the east (the direction of the refinery), the less vegetation there was. It is also interesting to note that the homes in the most eastern most part of the study area were fairly poor. This was the poorest place out of all the study areas, though other places in St. Rose were quite wealthy. Additionally, each street had houses that appeared to have been built during the same time frame, though overall, St. Rose appeared to be the youngest study area (however there were a few homes that appeared to be considerably older than the majority of those in the study area). Birds, especially batture birds, were attracted quite a lot to vegetative variables in St. Rose. Perhaps this was due to there being lesser amounts of vegetation that led the birds to congregate in areas with trees and plants. Birds may have been seeking out vegetation in St. Rose because they were used to the large amounts of vegetation in the area around St. Rose.

River Ridge and Harahan adjoined one another. Indeed, I split this area into two in order to make it more manageable for data gathering, and also to avoid having a study area that was so much larger than the others. Not surprisingly, the two areas were fairly similar to one another, though there were differences. The Harahan study area has a golf course right in the middle of it. This study area was patchwork in nature, meaning that different parts of the study area were different from one another. It appeared that different sections had been built at different times, there were a variety of lot sizes, some places had more vegetation than others, and there were neighborhoods of different economic standing. While Old Jefferson appeared to be the oldest study area overall, some parts of Harahan appeared to be built the same time as Old Jefferson. Nonetheless, there were also sections that appeared to have been built within the last few years (indeed, a house was under construction during the course of my surveys). River Ridge had more large homes on large lots than Harahan, and may have been the wealthiest study area. However, this study area lacked the patchwork attributes that were present in Harahan. For the most part, River Ridge was composed of middle class homes on lots of varying size, interspersed with the more wealthy homes. This study area had homes that appeared to have been predominantly built in the past few decades, making it the second youngest study area, following St. Rose. Indeed, it was far more uniform in composition than Harahan. Both study areas had similar amounts of vegetation, though Harahan had more and River Ridge appeared to have a more even distribution of vegetation. Both areas are surrounded by other residential areas. Harahan birds were more responsive to vegetative variables than the River Ridge birds.

It appears that the study areas that are the least uniform also have birds that are the most responsive to the independent variables, especially the vegetative ones. This may be due to the fact that in areas with a variety of habitats, birds can choose the ones they like best, and they often chose places with vegetation. Neighborhood age and socioeconomic status may also impact bird populations since neighborhoods of different ages and economic statuses have different vegetative structures. Older neighborhoods have more vegetation that is evenly spread out, whereas younger ones have less vegetation that is not evenly spread (Clergeau et al. 1998; Faeth et al. 2005). Jefferson was an older neighborhood that had an even spread of vegetation, and also had a fairly even spread of birds, both in abundance and richness. St. Roses was the youngest study area, and it had less vegetation, but birds reacted strongly to the vegetation that was present. Also present in St. Rose was the poorest neighborhood of all the neighborhoods in my study area. This place was particularly devoid of vegetation. Interestingly, many of the more wealthy neighborhoods were also vegetation poor, and also appeared to be newer than most places in the study area. The most wealthy study area, River Ridge, had birds that did not react strongly to vegetative variables. The wealthy neighborhoods in Harahan and River Ridge (there were none in Old Jefferson), often had the same attributes as the wealthy areas in St. Rose, namely, little vegetation. Middle class neighborhoods appeared to have the most vegetation. St. Rose and Harahan were the two study areas with the most variety in the spread of vegetation, socioeconomic factors, and neighborhood age. These were also the study areas that had birds that responded the most to the independent variables. It appears that birds in areas that have little variety spread themselves out evenly, whereas birds in areas with a variety of urban habitats are able to live in the ones that they prefer. Indeed, some of my findings appeared to mirror those that were reported in Clergeau et al. (1998).

There were a few flaws in this study. As mentioned earlier, many birds started and flew away from a survey point when they saw my approach, and did not return. In future studies it may be useful to plan to have a little time for the birds to settle down. It also would have been better to start all surveys at a standard time after sunrise. I did attempt to do this, but unexpected events prevented this from happening. One survey was done under poor conditions that still fell within the protocol. It would have been better to have more stringent protocol to ensure optimal conditions for detecting birds. A few data points had to be thrown out because of errors in measuring distance from the batture. These errors were discovered after I had learned to use features on GIS that allowed me to map my study area. It would have been better to have used GIS from the beginning to prevent errors in measuring distance from the batture. I am also not the most experienced birder, and there may have been some birds I misidentified or was unable to identify. There was no way around this problem since I had no funds to pay for the assistance of a more experienced birder. This is illustrated by the grackle error in the data. Most of the grackles detected were Common Grackles, but I learned this after the surveys were done. Because of this oversight, I was unable to include grackles into the batture or urban bird guilds, which was unfortunate since they were one of the most numerous birds detected. Nonetheless, I did take as many steps to ensure accuracy as was possible, and the general trends in the study should be accurate. Along this same theme, as the surveys went on, I got better at identifying birds. Thus, later surveys are more accurate than earlier ones.

One obstacle I encountered was that I was unable to find many papers discussing urban bird distributions, and especially those dealing with those populations over multiple seasons. There are papers about urban birds, but they often deal with how birds respond to disturbances, predators, urbanization gradients. More studies like the present one would be useful. This is an area of research in which there is plenty of opportunity for new studies that would help explain what is going on with bird populations in cities and why. One area that would be of interest would be to do a more thorough survey of vegetation in yards to determine how much of it is exotic and how that impacts bird populations. It would also be interesting to go to places up or down river that have wider swaths of intact batture to see if this leads to more batture birds. Perhaps there are other rivers that are not lined with a 50 meter levee in which a similar study could be done to see if having a fairly unvegetated area right next to natural habitat changes the way birds interact with the study area. I also noticed that grackles and European Starlings avoided places with canopy cover, and Purple Martins were frequently found in sunny areas. All of these birds are iridescent, and it would be interesting to see if iridescent birds seek sunny areas.

A study similar to this one could easily be undertaken in other cities. I believe the results would be similar to those of this study, but the only way to confirm this is to try this study in other places. It is very likely that other native birds or non-urban birds would react similarly to vegetation regardless of location. Another study like this one would probably have a similar outcome. Such studies would have survey areas around woodlots, nature reserves, and other like places to see how birds are influenced by these areas. One point of interest is that the study areas were some of the most vegetated areas in the New Orleans Metropolitan area, as can be seen by looking at a satellite image of the city. This was not done intentionally, and was only discovered after the study was concluded. However, bird populations in other areas of New Orleans may be different than those found in the study.

CONCLUSION

Batture birds very much preferred areas with more vegetation, regardless of season. Urban birds used areas with vegetation during the spring, but generally avoided it during the summer. Some species of urban birds avoided places with canopy cover at all times. Though the batture itself was not as important to bird populations as I originally had hoped it would be, this does not mean that it contributed nothing to bird populations. Indeed, in the summer, there was greater batture bird richness in the areas nearer the batture. Some of the spring surveys found that, in a few limited areas, batture birds were more abundant closer to the batture. More importantly, the batture is a place with large quantities of vegetation. In this study, places with lots of vegetation were the places with the greatest richness for all categories of birds in the spring and for batture birds during the summer. It was interesting to note that non-native urban birds avoided places with large percentages of canopy cover, but even urban birds that are native to the area seemed to prefer areas with greater vegetation. It is possible that higher percentages of vegetation, especially canopy cover, is a deterrent to non-native urban bird species, but is beneficial to native bird species, regardless of whether or not they are urban birds or batture birds. In study areas where birds had a variety of habitats to choose from, the often chose to be in those with more vegetation. This may useful information for home owners interested in attracting birds to their yard and keeping non-native species out. It may also be of interest to city planners that want to help out native bird species in their neighborhoods. The best place for batture and spring birds appears to be areas with trees, canopy cover, and understory vegetation.

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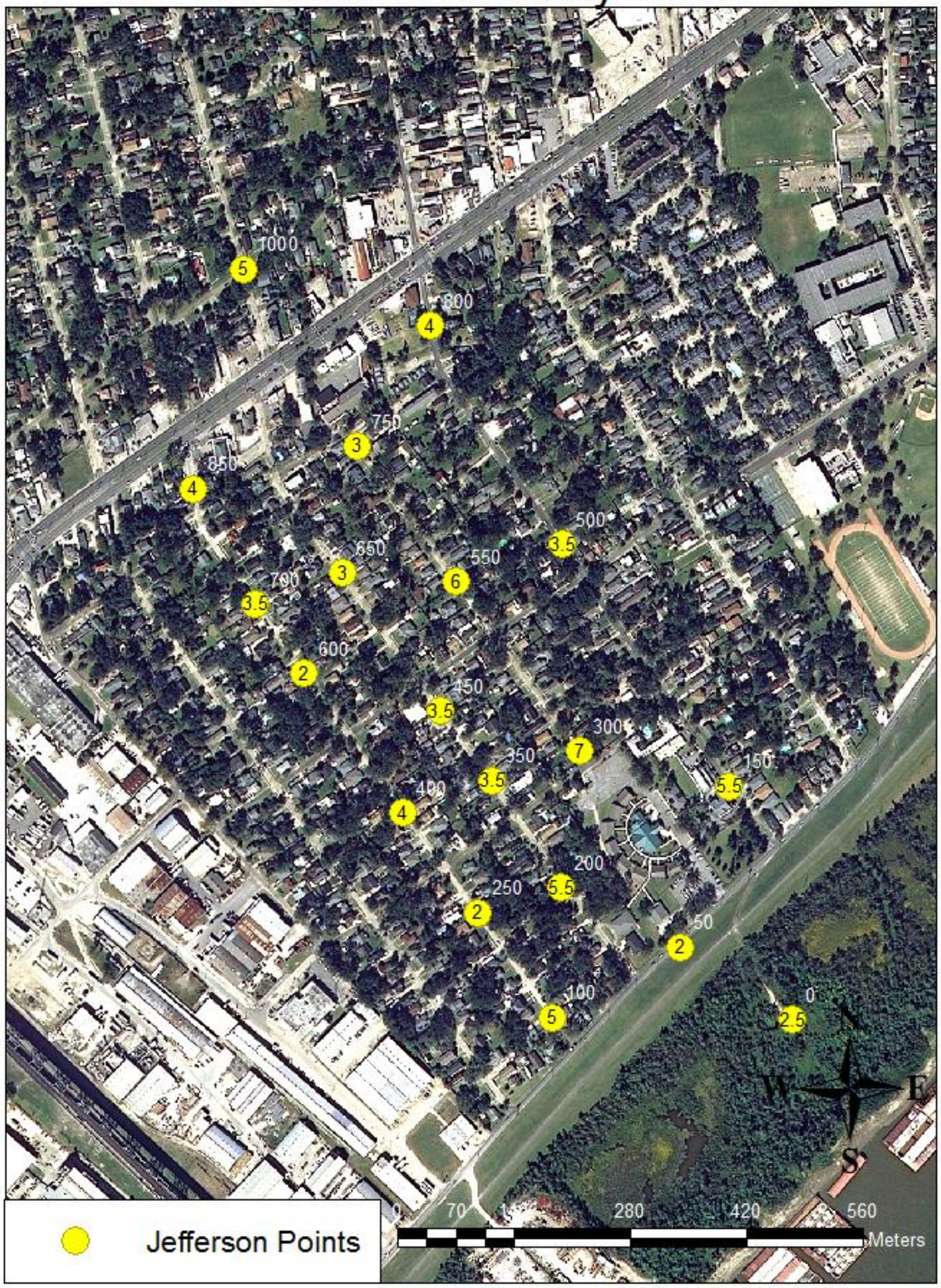
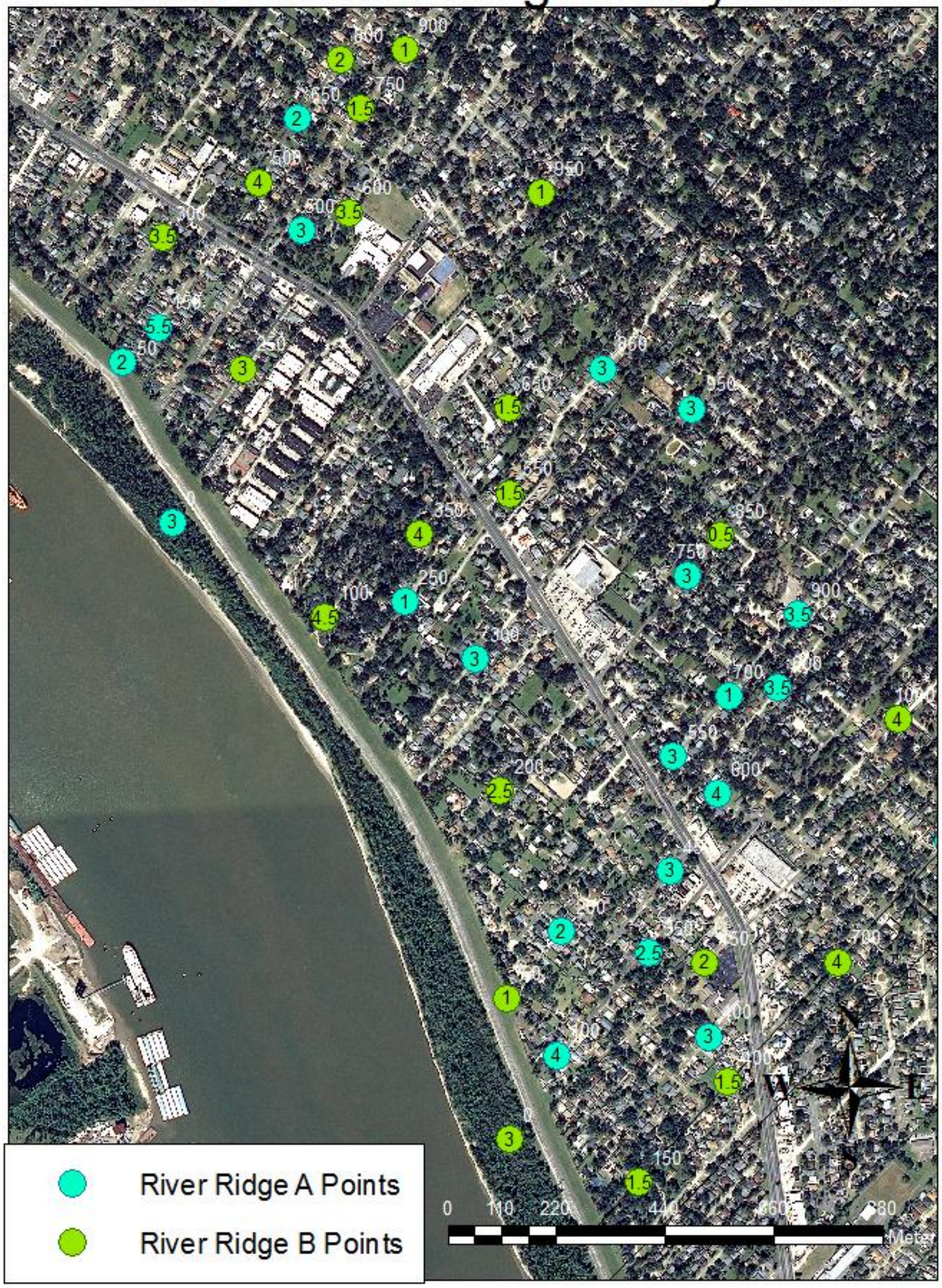
Appendix – Maps

Spring Richness at Survey Points in Jefferson Study Area



Map A

Spring Richness at Survey Points in River Ridge Study Area

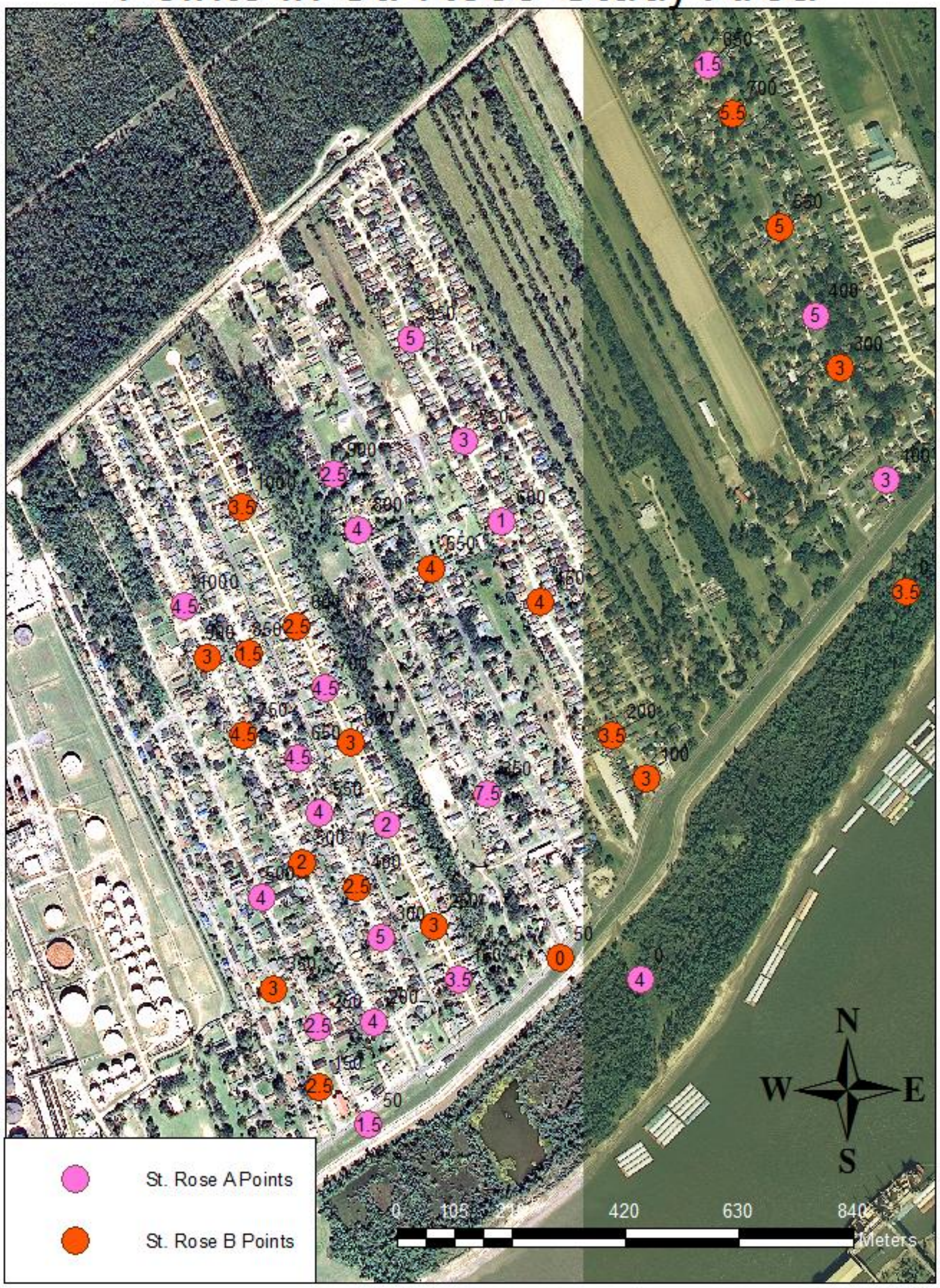


Map B

Spring Richness at Survey Points in Harahan Study Area

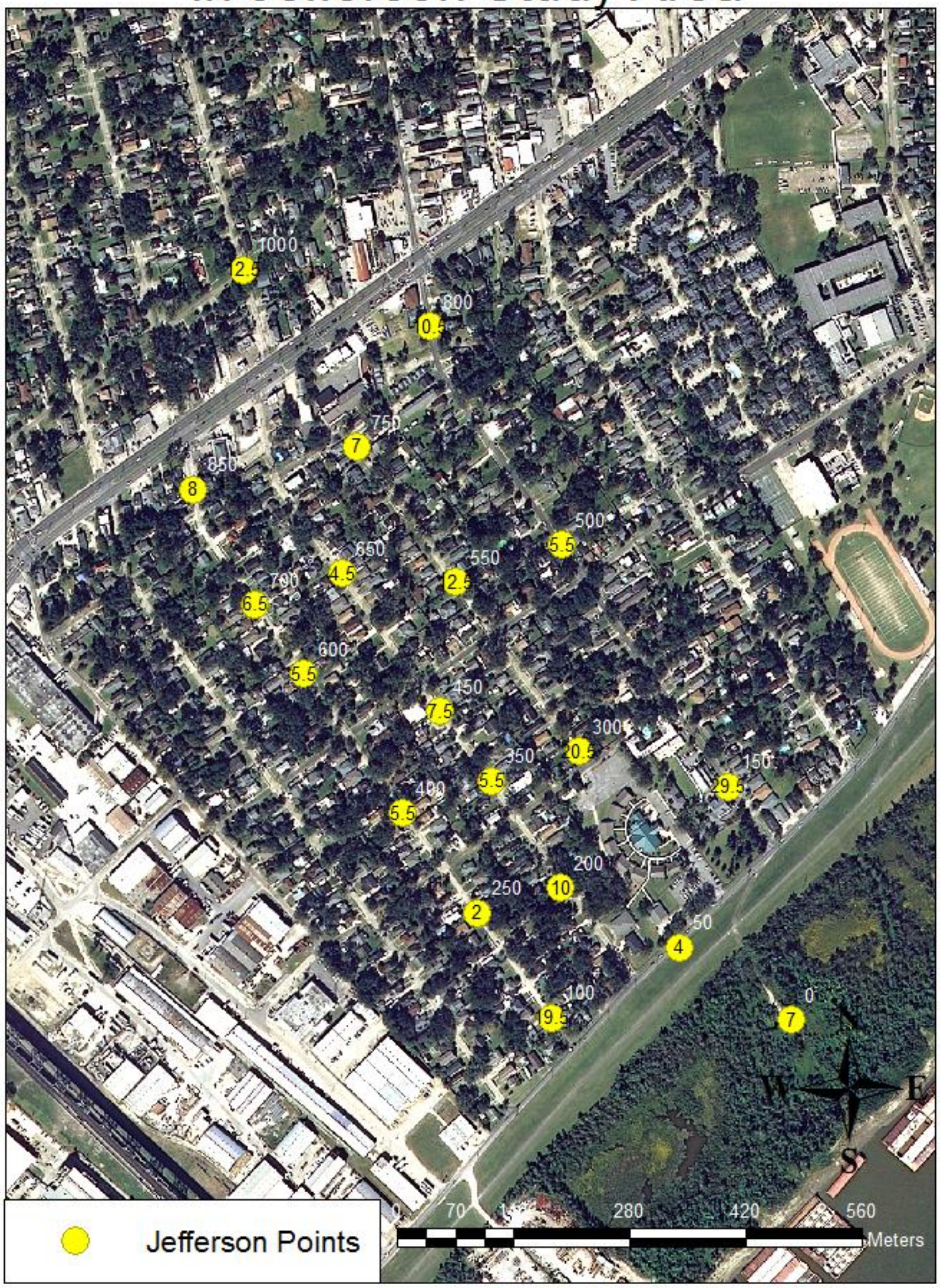
Map C

Spring Richness at Survey Points in St. Rose Study Area

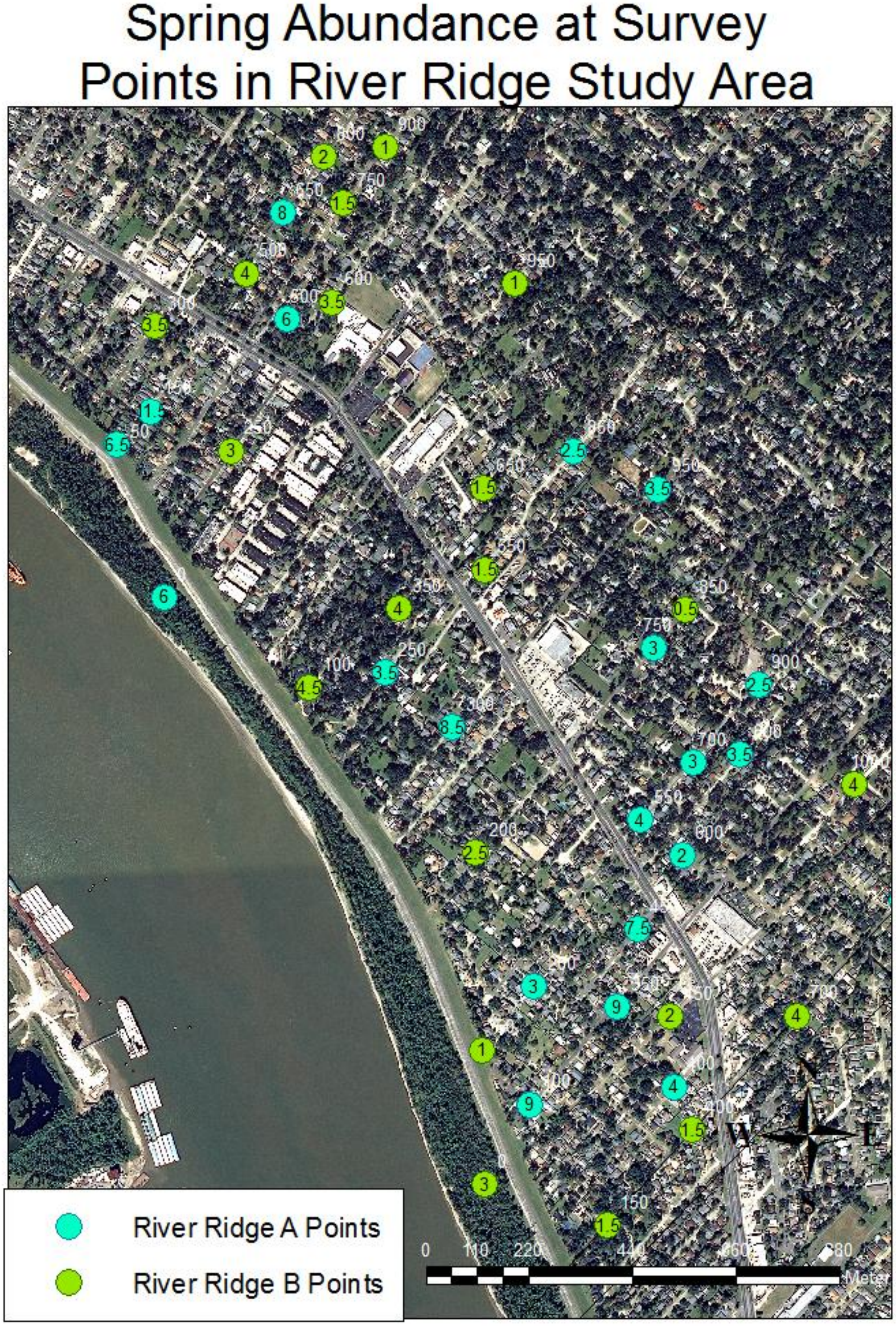


Map D

Spring Abundance at Survey Points in Jefferson Study Area



Map E

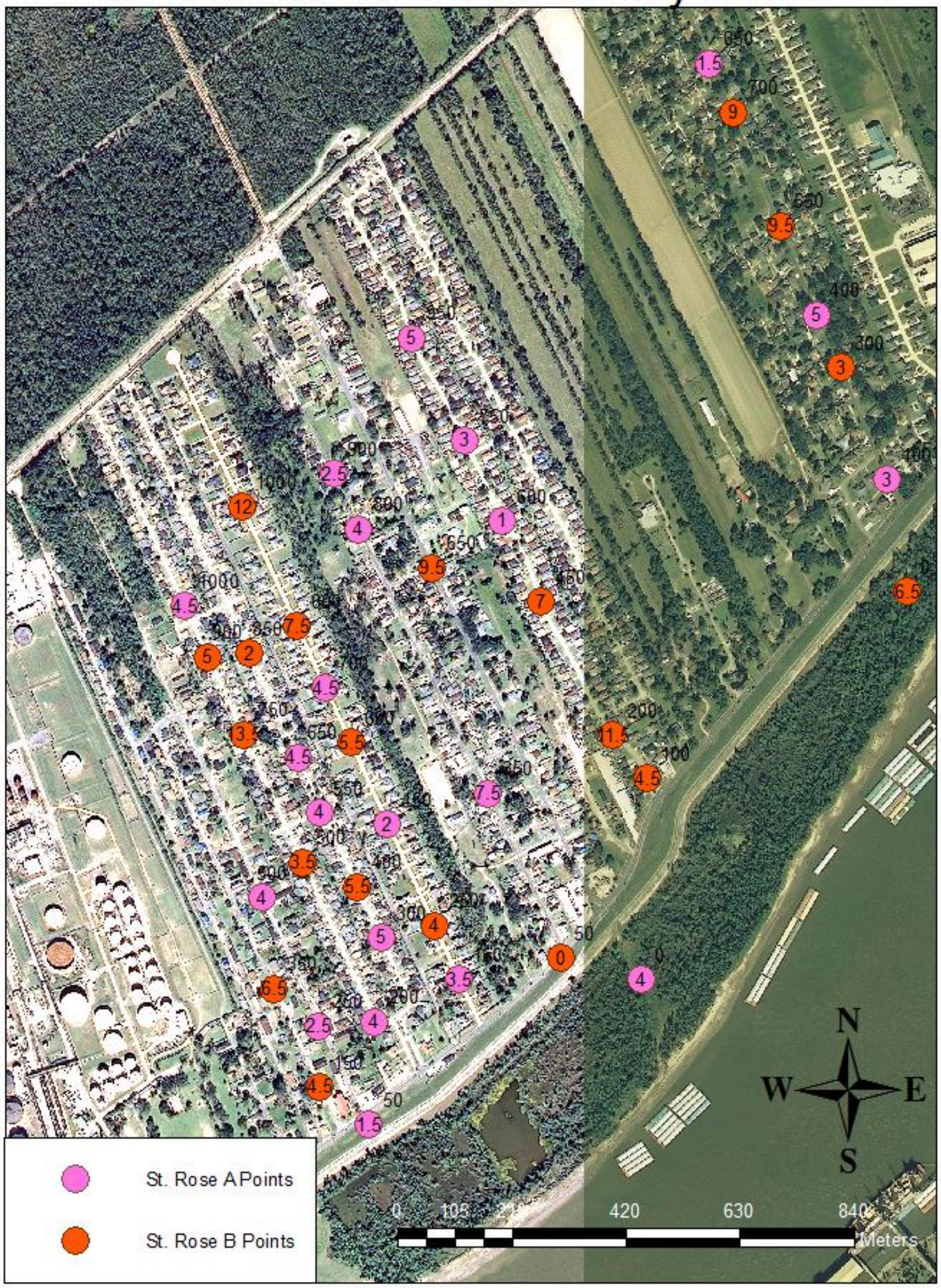

Spring Abundance at Survey Points in River Ridge Study Area
River Ridge A Points
River Ridge B Points
W
E
Meters

Map F

Spring Abundance at Survey Points in Harahan Study Area

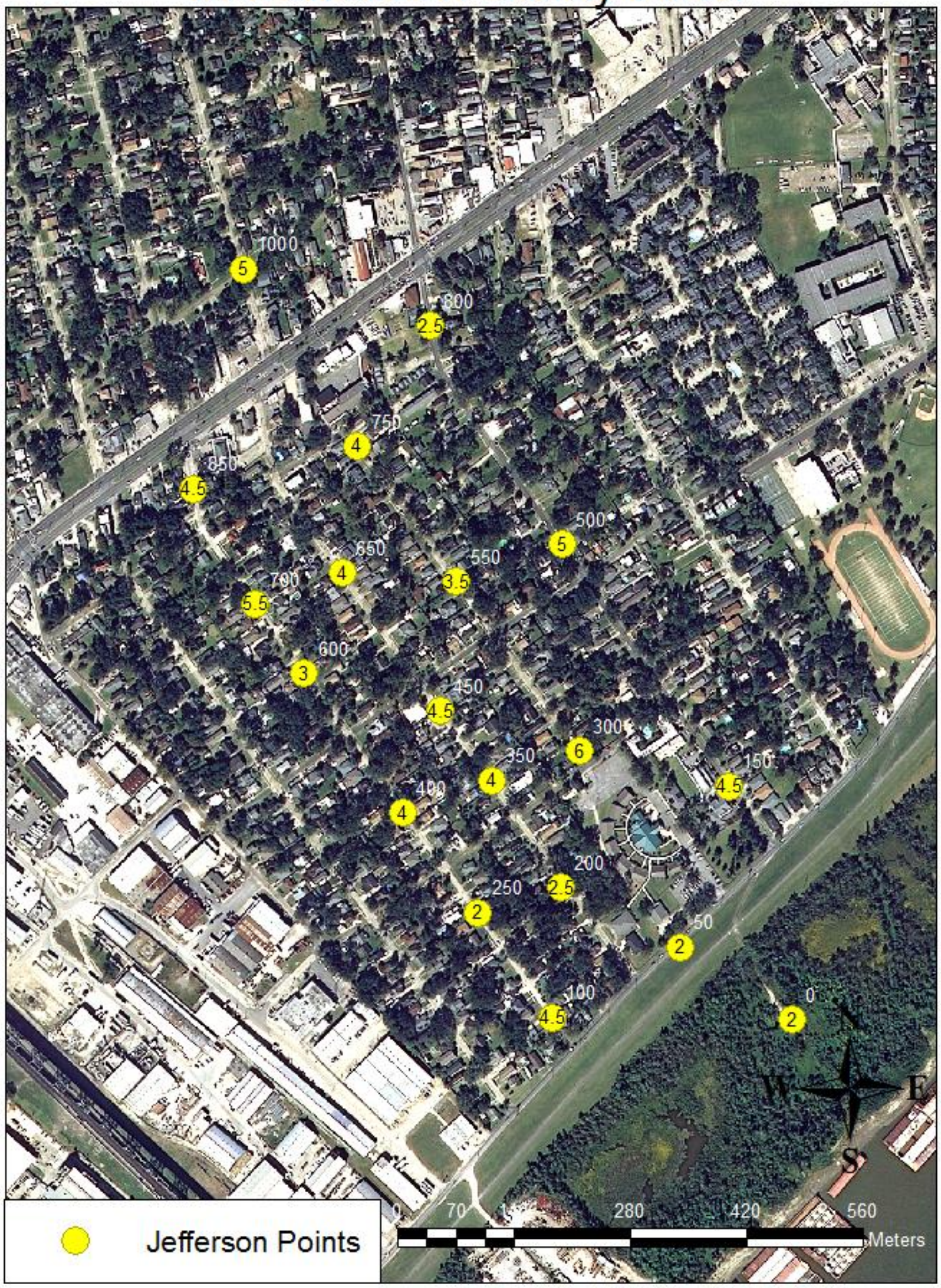
Map G

Spring Abundance at Survey Points in St. Rose Study Area



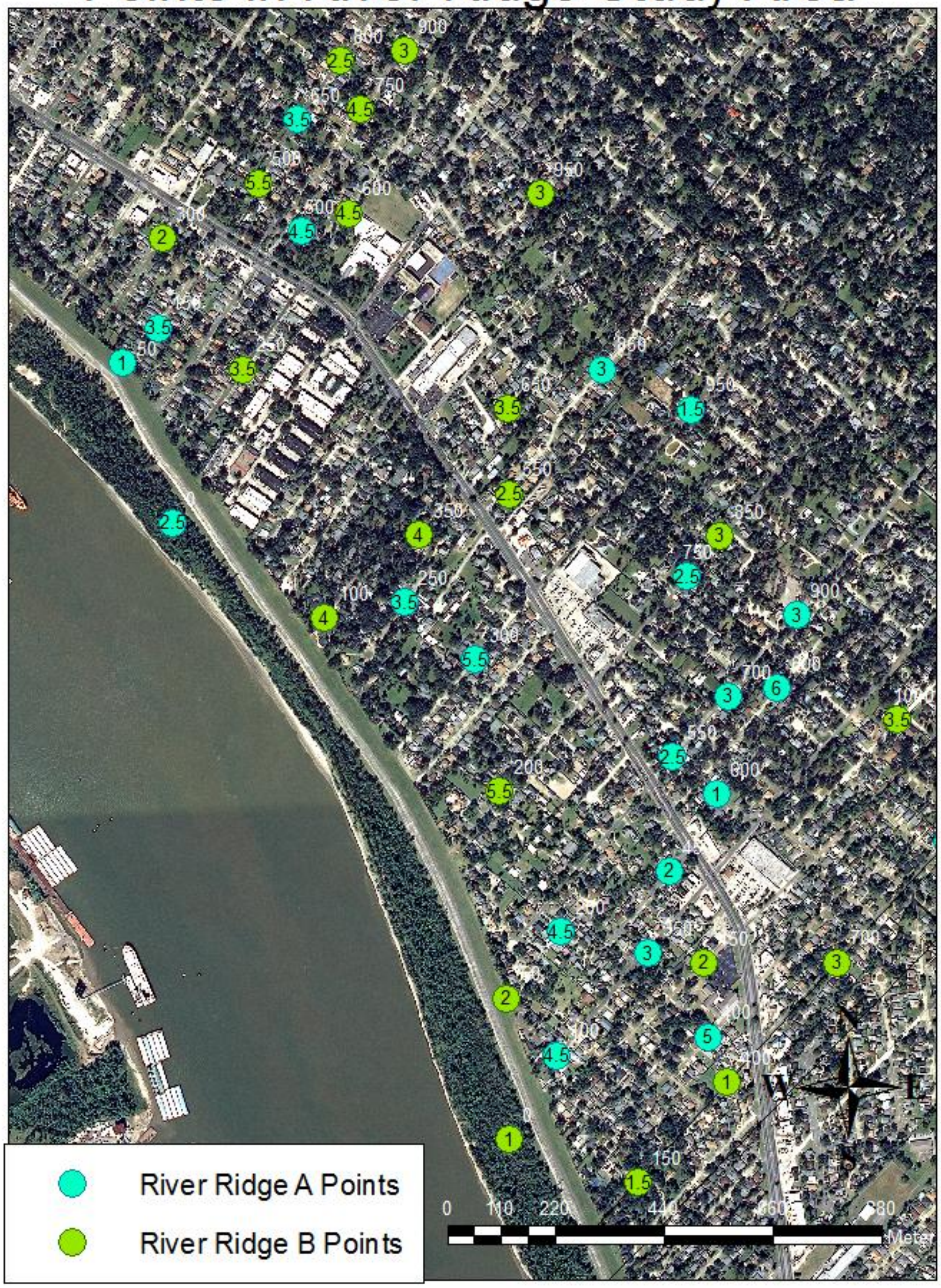
Map H

Summer Richness at Survey Points in Jefferson Study Area



Map I

Summer Richness at Survey Points in River Ridge Study Area

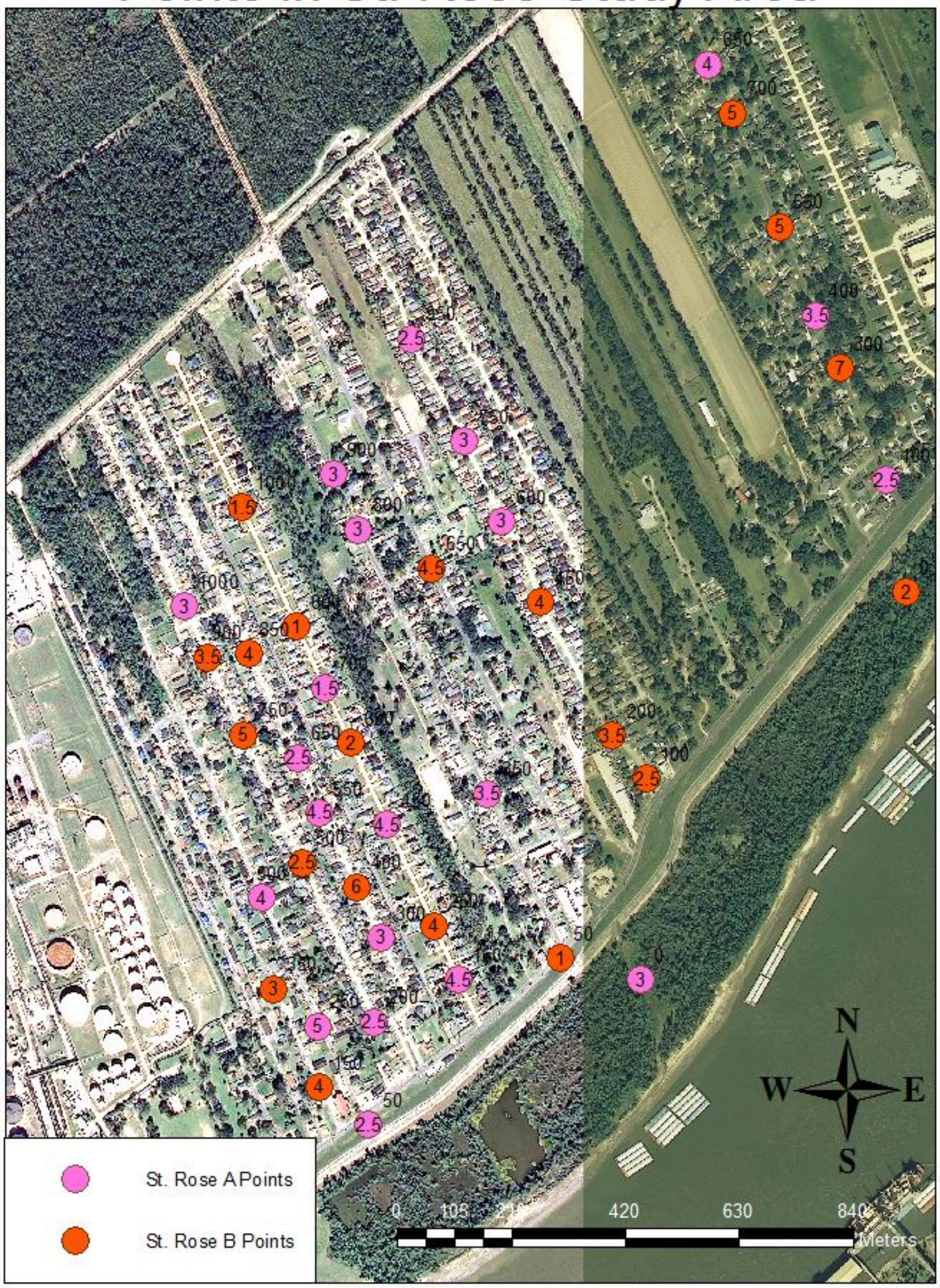


Map J

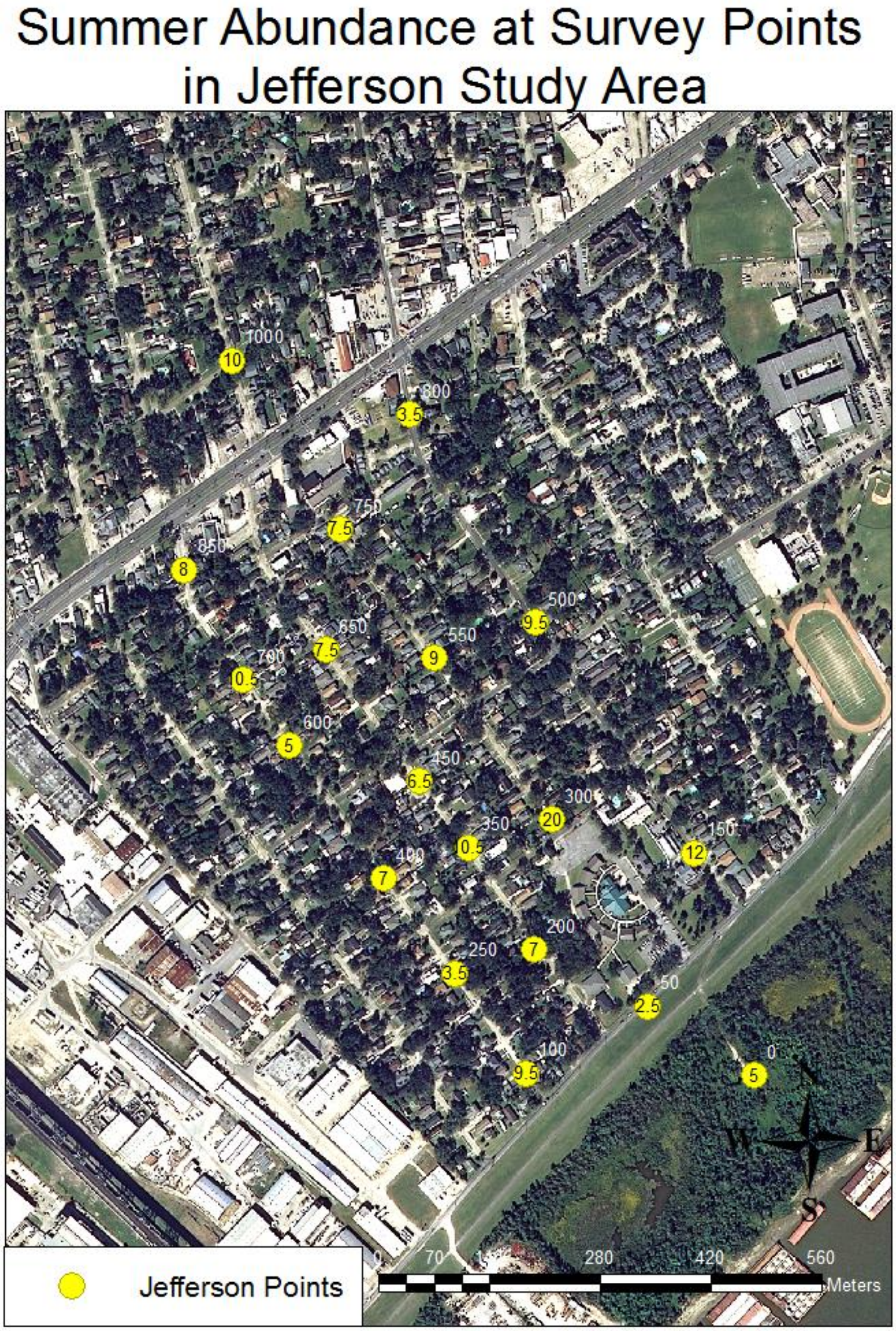
Summer Richness at Survey Points in Harahan Study Area

Map K

Summer Richness at Survey Points in St. Rose Study Area

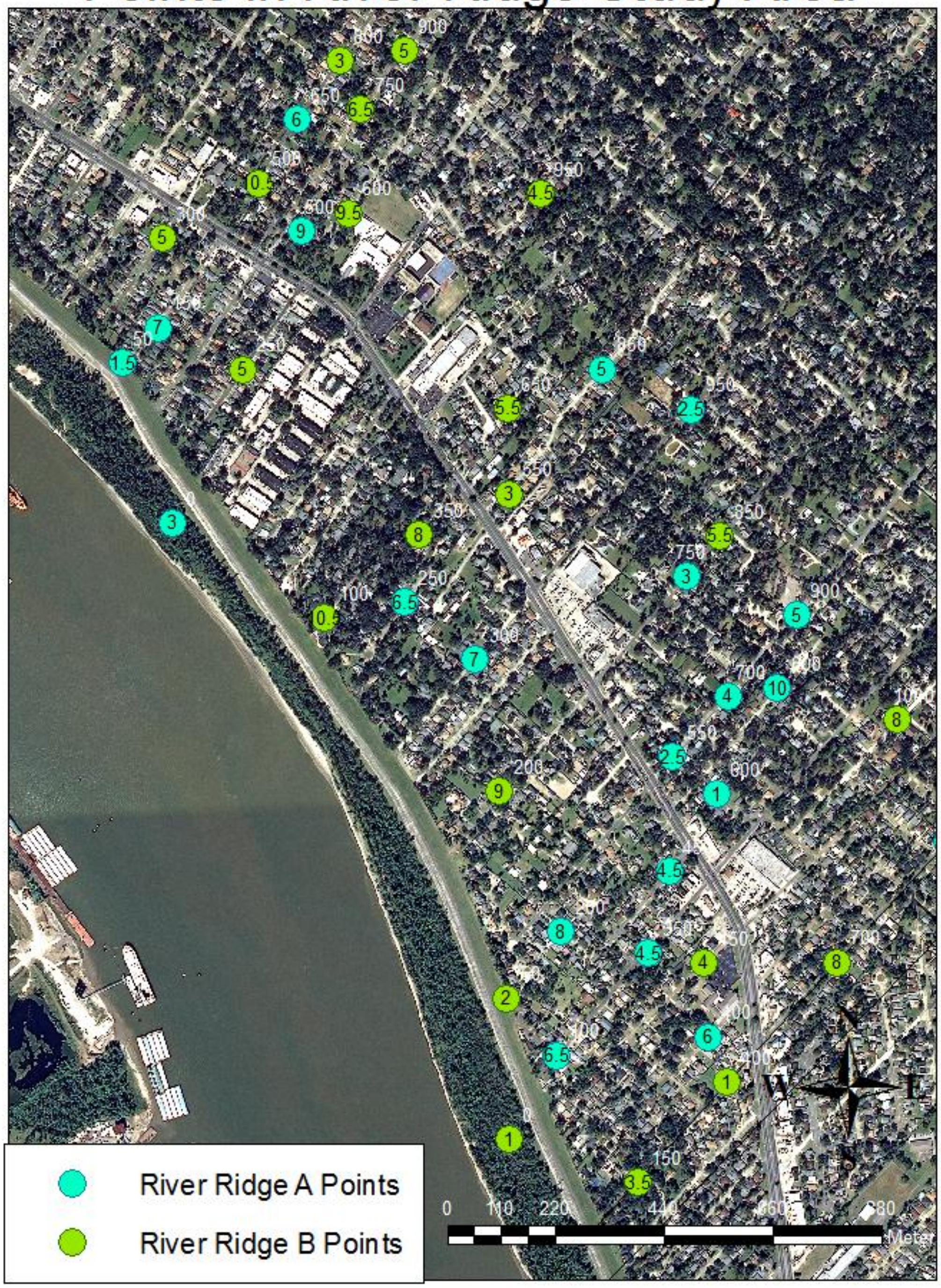


Map L


Summer Abundance at Survey Points
in Jefferson Study Area
1000
10
800
3.5
750
7.5
850
8
500
9.5
650
7.5
550
9
700
0.5
600
5
450
6.5
300
20
150
350
0.5
12
400
7
200
7
250
3.5
50
2.5
100
9.5
0
5
N
W
E
S
0
70
280
420
560
Meters
Jefferson Points

Map M

Summer Abundance at Survey Points in River Ridge Study Area

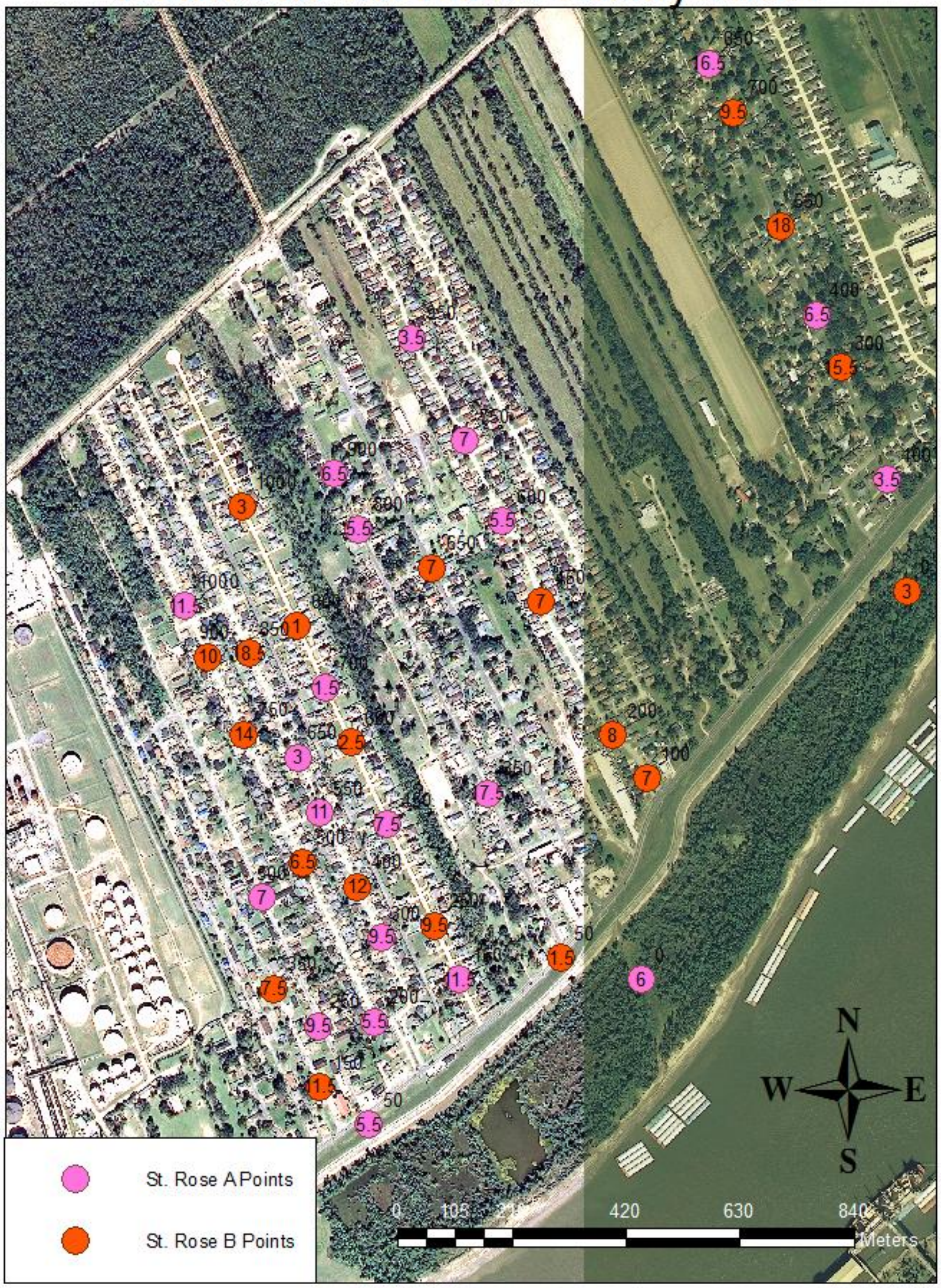


Map N


Summer Abundance at Survey
Points in Harahan Study Area
Harahan A Points
Harahan B Points
0 130 260 520 780 1,040
Meters
N
S
W
E

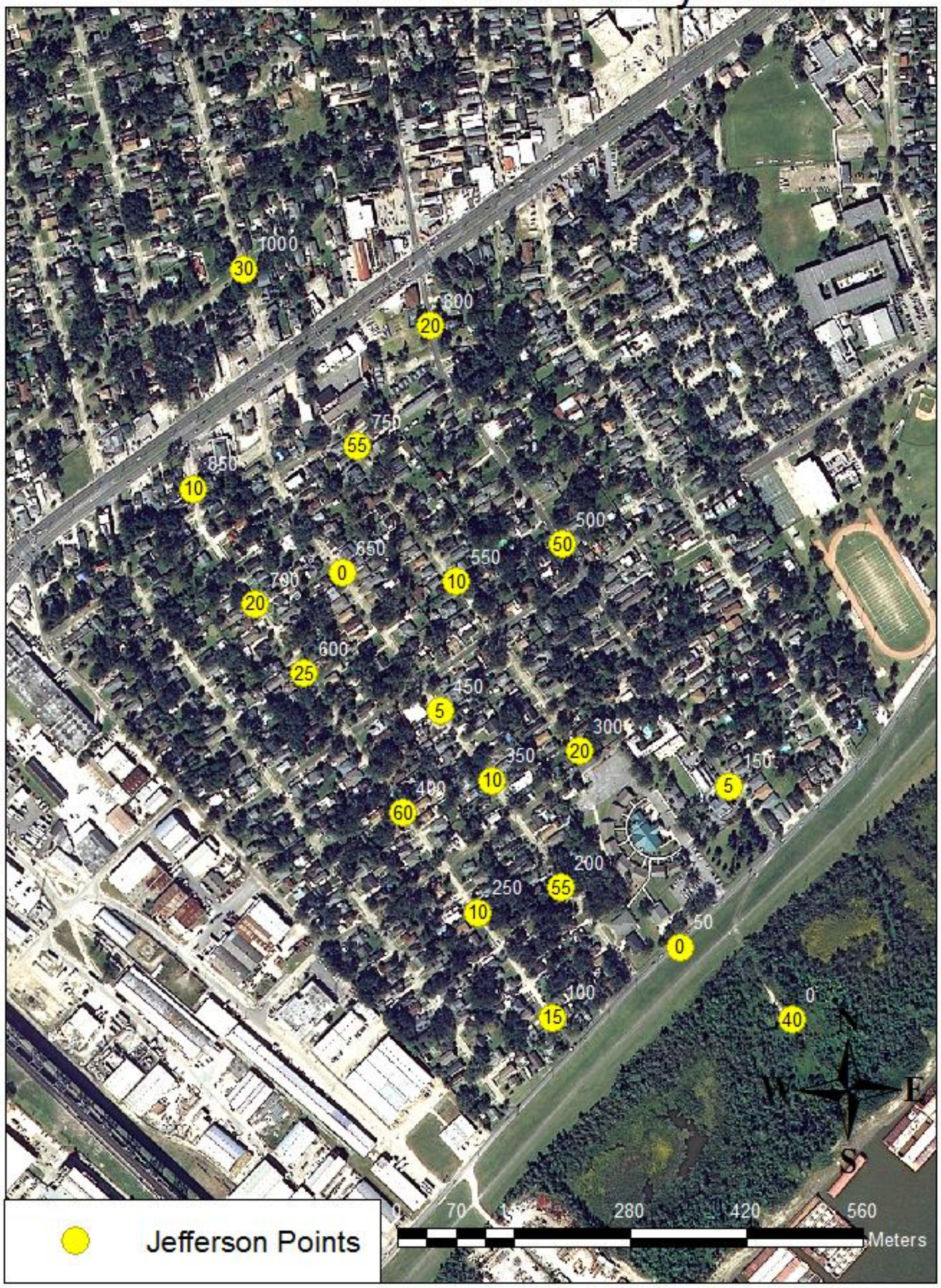
Map O

Summer Abundance at Survey Points in St. Rose Study Area



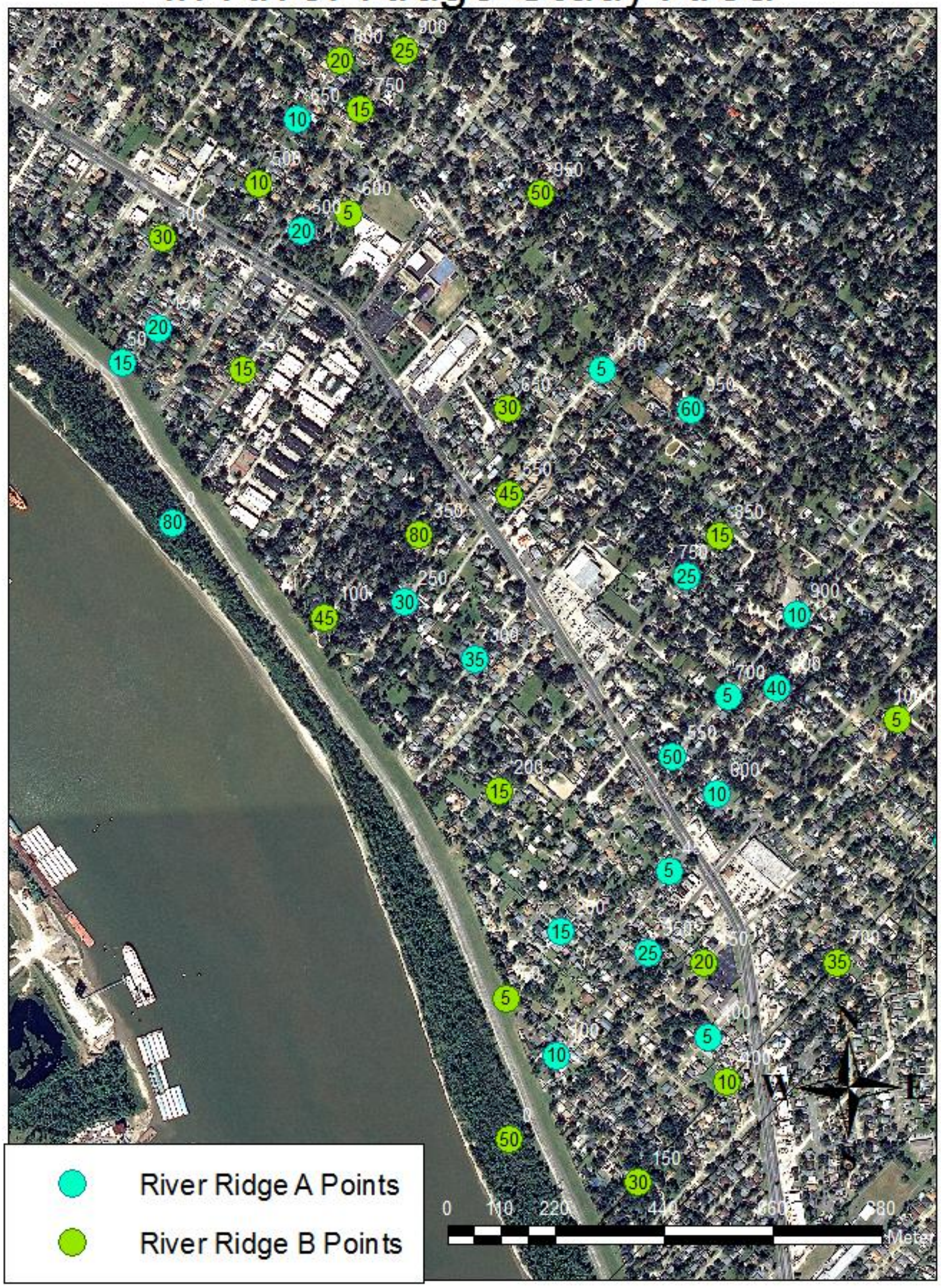
Map P

Percentage of Canopy Cover at Survey Points in Jefferson Study Area



Map Q

Percentage of Canopy Cover at Survey Points in River Ridge Study Area

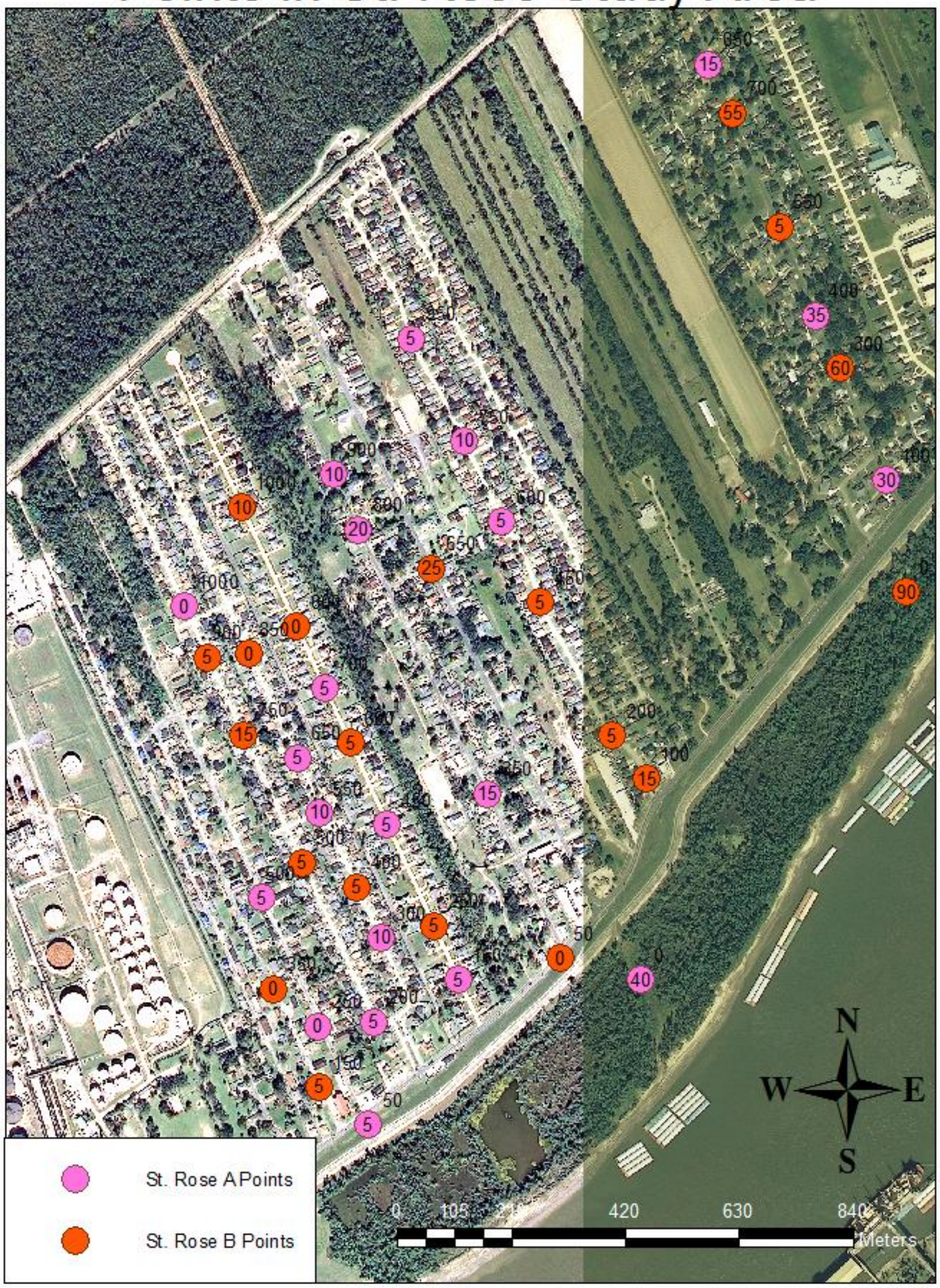


Map R

Percentage of Canopy Cover at Survey Points in Harahan Study Area

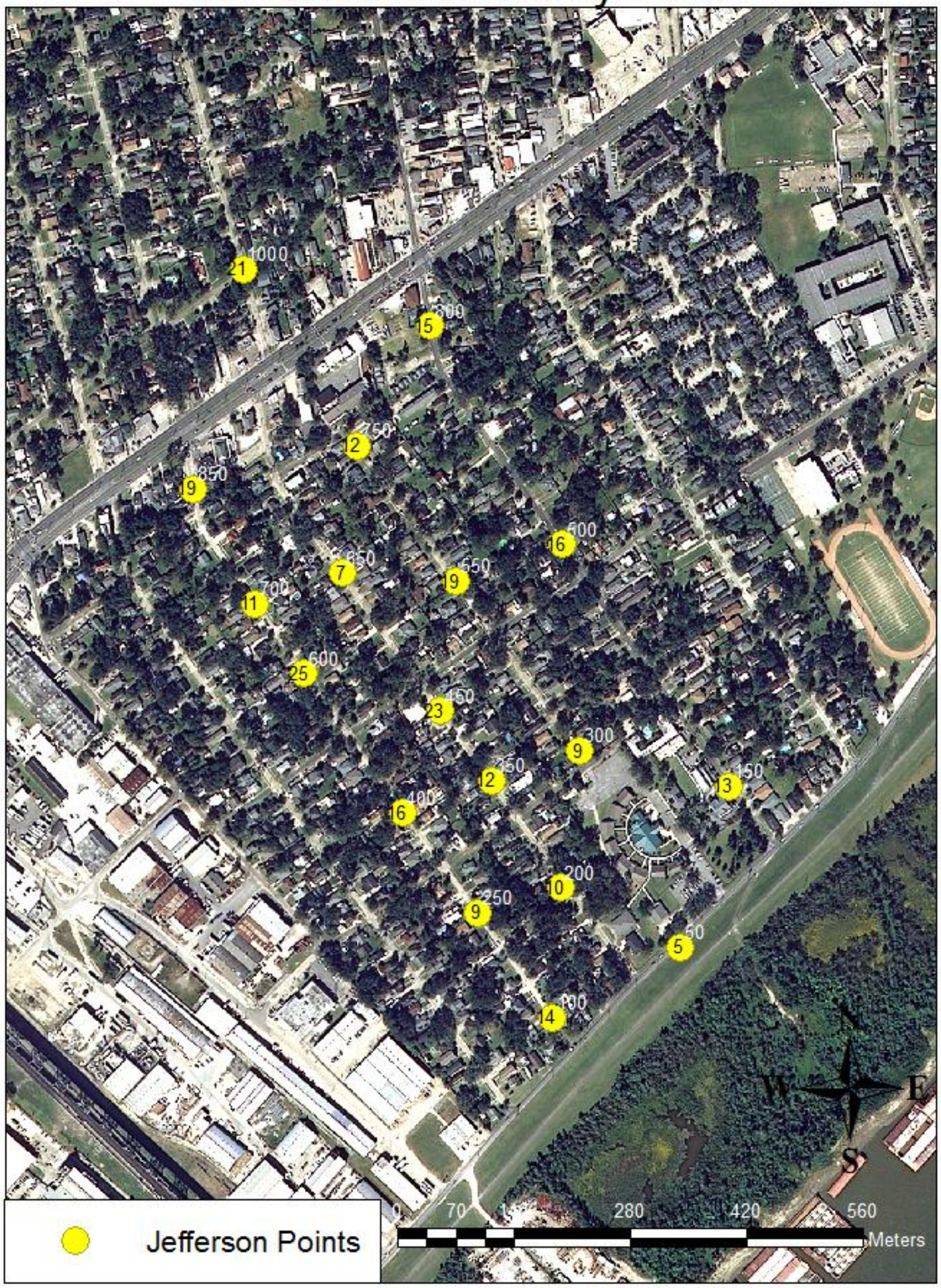
Map S

Percentage of Canopy Cover at Survey Points in St. Rose Study Area



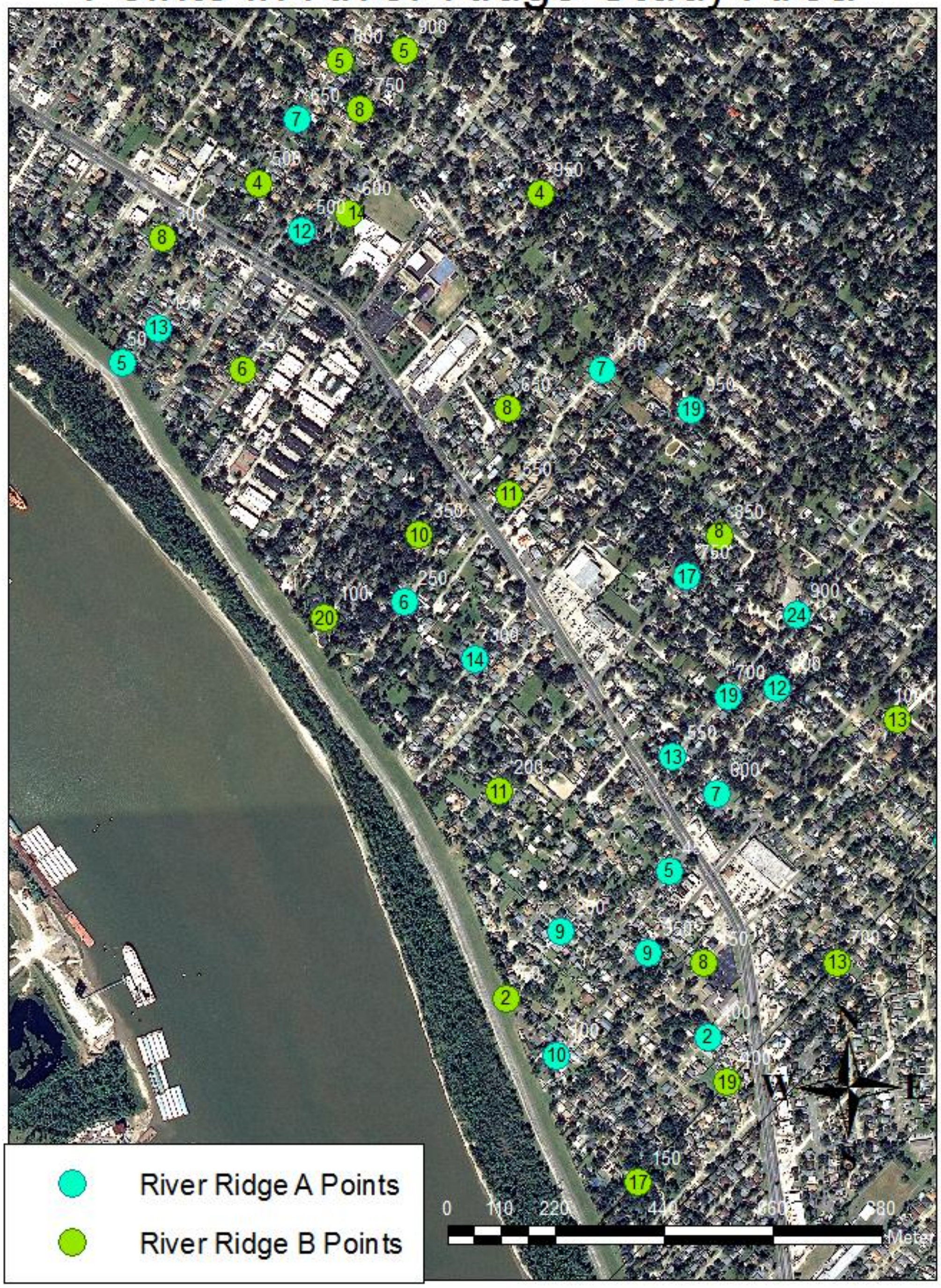
Map T

Number of Trees at Survey Points in Jefferson Study Area



Map U

Number of Trees at Survey Points in River Ridge Study Area

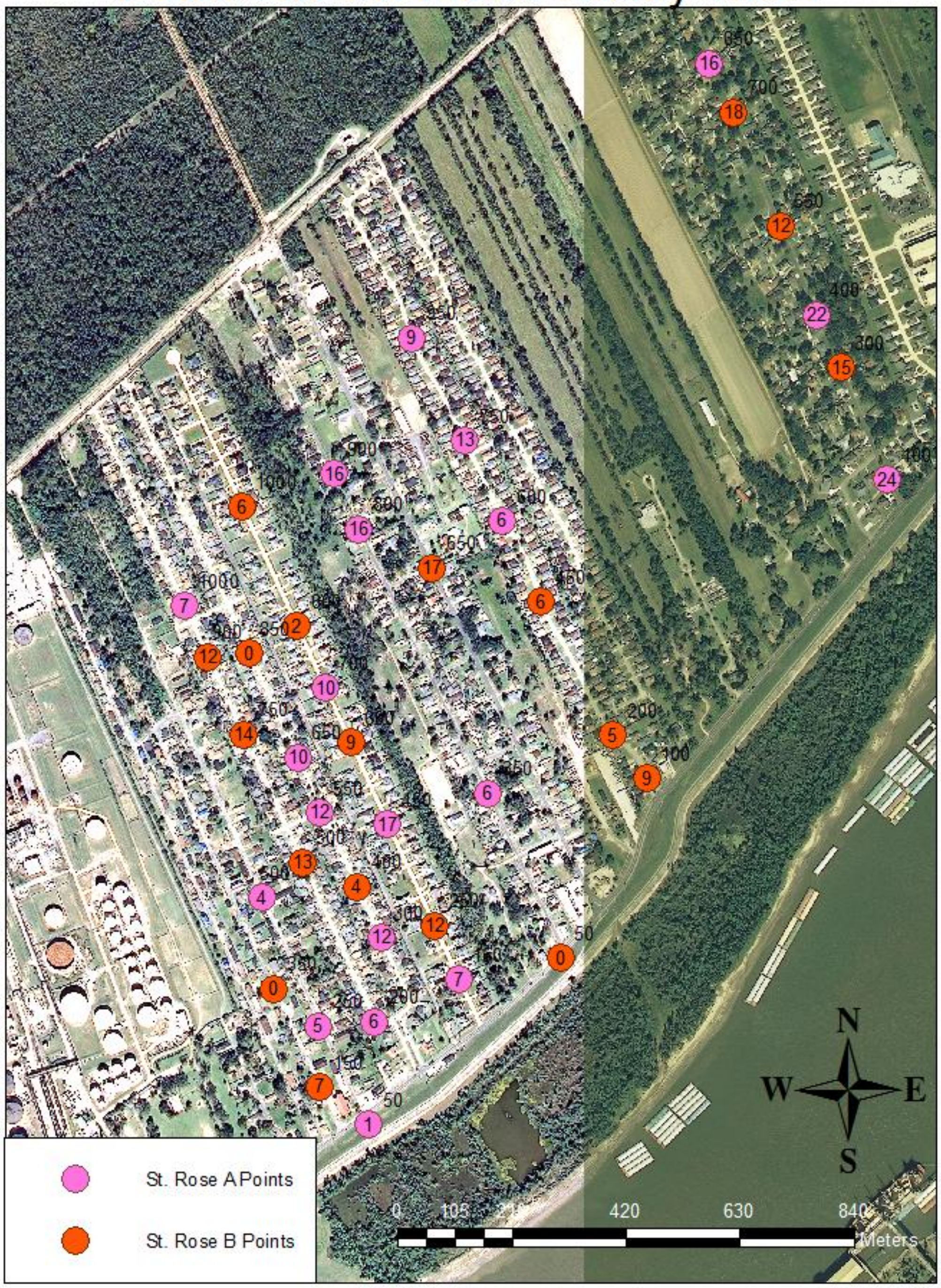


Map V

Number of Trees at Survey Points in Harahan Study Area

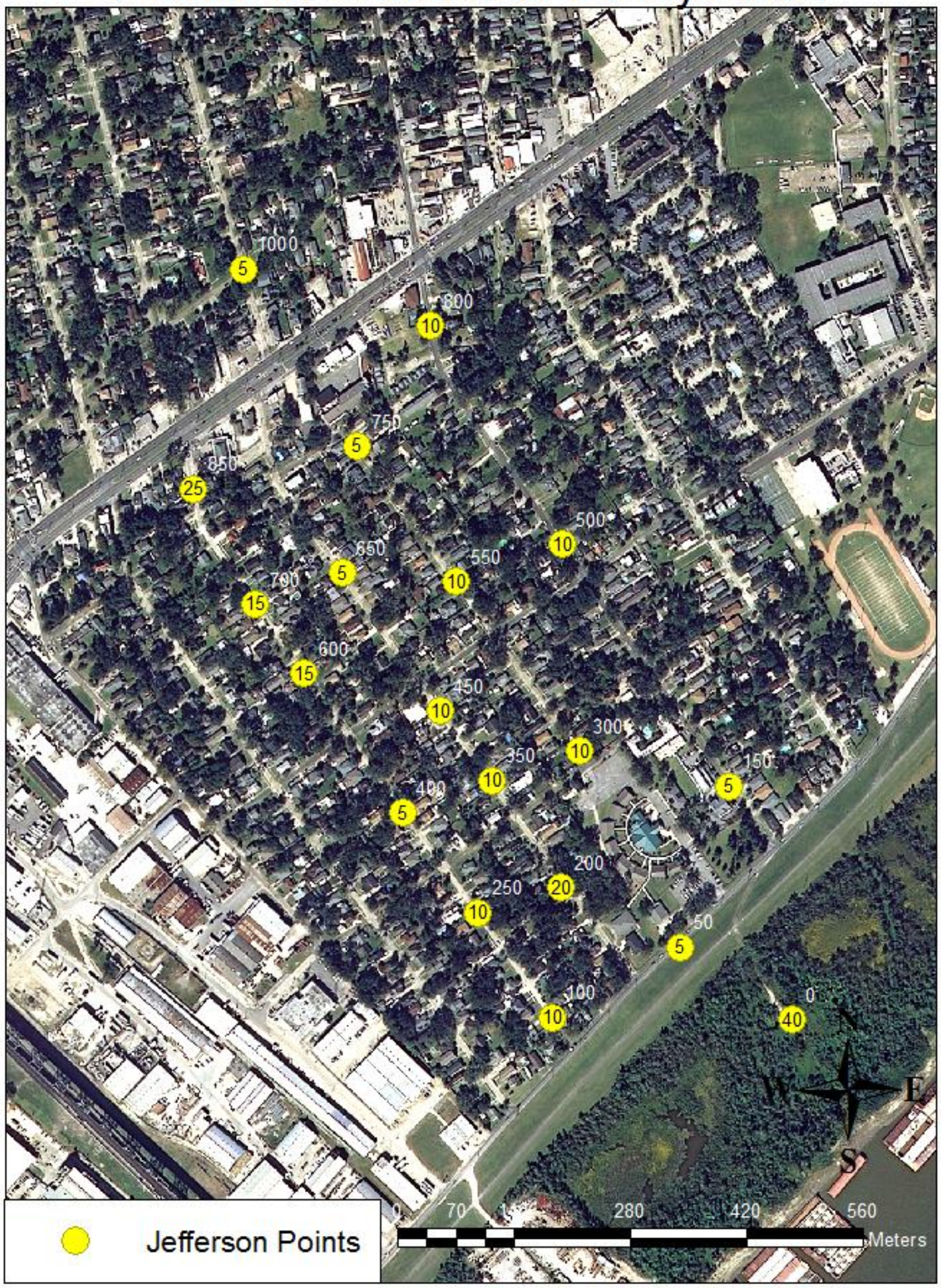
Map W

Number of Trees at Survey Points in St. Rose Study Area



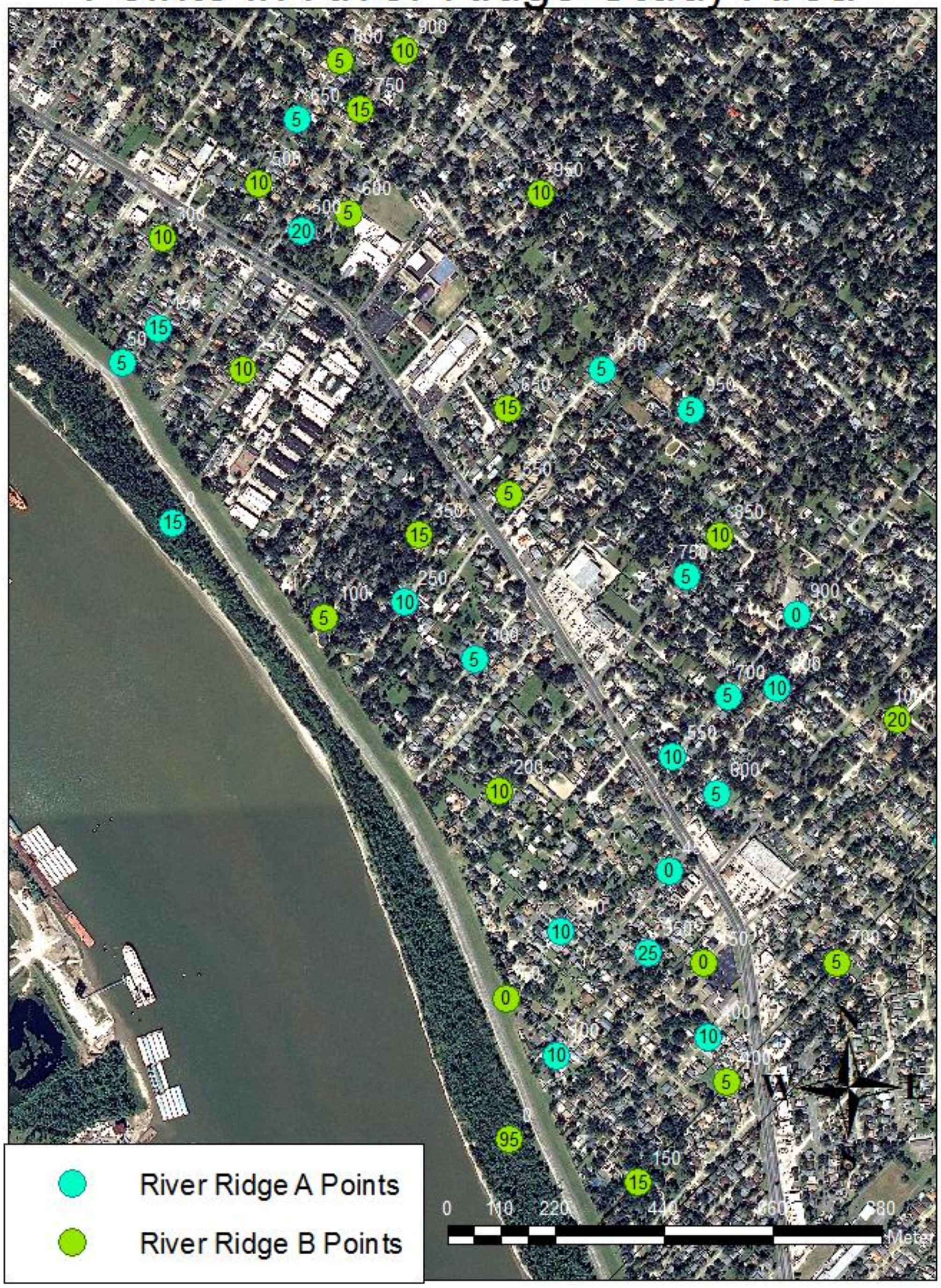
Map X

Percentage of Under Story Cover at Survey Points in Jefferson Study Area



Map Y

Percentage of Under Story Cover at Survey Points in River Ridge Study Area

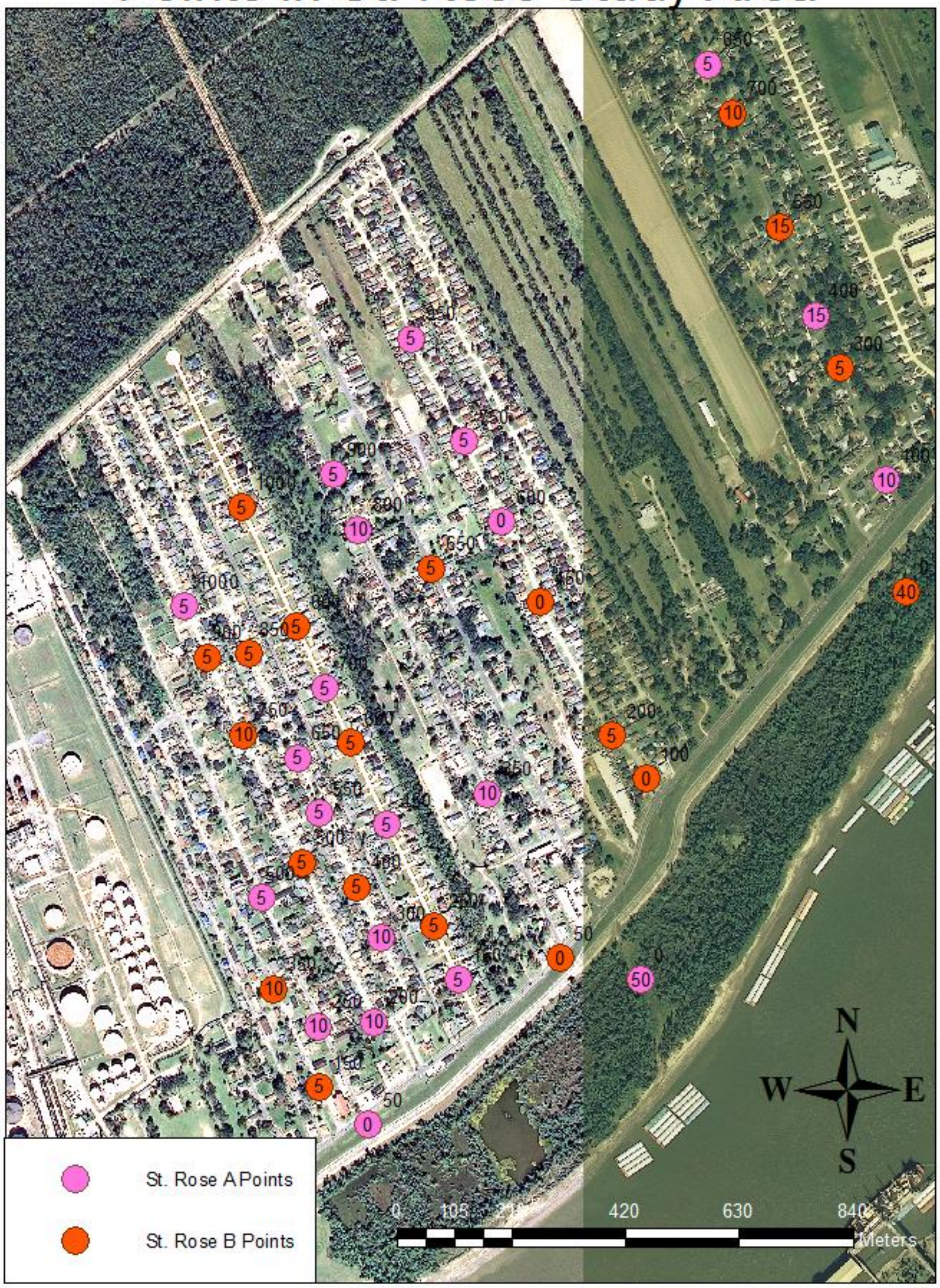


Map Z

Percentage of Under Story Cover at Survey Points in Harahan Study Area

Map AA

Percentage of Under Story Cover at Survey Points in St. Rose Study Area



Map BB

Vita

Ruth Anne Guymon attended Brigham Young University - Idaho and graduated with an associate's degree in Pre-Law/Political Science in August 2002. She worked during the summer of 2007 as an intern for the Monitoring Avian Productivity and Survivorship (MAPS) program, offered by the Institute for Bird Populations (IBP). In August of 2007, she earned her bachelor's degree from Brigham Young University in Environmental Geography. For a short period of time, from August to November of 2011, she assisted the United States Geologic Service (USGS) conduct a study on Willets. She will graduate from the University of New Orleans in August of 2012 with a master's degree in Geography, emphasizing Environmental Geography and GIS/Remote Sensing. Ruth has had an interest in birds ever since she became aware of her sister's parakeet when she was only two years old. This interest was helped along when she was in the third grade, at which time she received prescription glasses, which allowed her to actually see the birds that were in her immediate surroundings.